ANNUAL REPORT IVL SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE

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CITIES ARE GROWING, PARKING SPACES ARE SHRINKING

URGENT EFFORTS THAT MAKE A DIFFERENCE

30 YEARS OF COOPERATION WITH CHINA

OUR SOCIETY IS LEAKING PLASTIC – WE HAVE TO CHANGE THIS

IVL CELEBRATES 50 YEARS // OUR OPERATIONS CONTRIBUTE TO SUSTAINABLE SOCIAL DEVELOPMENT // INTERNET OF THINGS TAKES ITS PLACE IN ENVIRONMENTAL RESEARCH // IVL GETS TO THE BOTTOM WITH THE ASCIDIANS // COMPETENT AND COMMITTED EMPLOYEES ARE THE KEY TO SUCCESS // GRI REPORTING IS DRIVING THE SUSTAINABILITY FORWARD

THIS IS IVL

PURPOSE
IVL Swedish Environmental Research Institute conducts applied research and consulting projects aimed at promoting ecologically, economically and socially sustainable growth in the business sector and the rest of society.

VISION
IVL's vision is a sustainable society. We are driving the transition to a sustainable society by transforming:

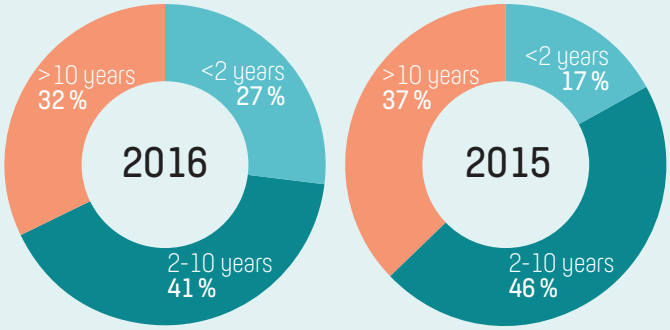
- science into reality
- environmental problems into opportunities
- linear processes into a circular economy.

CORE VALUES
IVL's core values are based on credibility, a holistic and forwardlooking approach, commitment and benefit.

SWEDEN'S FIRST ENVIRONMENTAL RESEARCH INSTITUTE
IVL was jointly established by the Swedish State and the business sector in 1966. IVL has been operated as a public limited company since 1982. The company is owned by the Swedish Water and Air Conservation Foundation (SIVL).

EMPLOYEES AND EXPERTISE

Length of service



The average period of employment is 10.6 years (10).
Of IVL's employees, 92 per cent are permanent employees.

ALL INDUSTRIES COVERED
Today, IVL operates on a broad basis across the entire spectrum of sustainability. Activities span every industry, and we serve customers in all parts of Swedish society.

FOUR FOCUS AREAS
IVL's operations are organised into four operational units, as well as units for research, business development and marketing. In addition, there are staff functions tasked with finance, human resources, IT and communications. All units work together in focus areas that simultaneously summarise IVL's market offerings in four focus areas: *Natural resources, climate & environment, Resource-efficient recycling & consumption, Sustainable production & environmental technology and Sustainable urban development & transport.*

BOTH RESEARCH AND CONSULTANCY PROJECTS
Just under half of IVL's activities consist of research commissioned directly by external customers. The remainder is made up of research that is either co-funded by the State and the business sector or grant-funded via State-owned research bodies, foundations or the EU.

PARTNERSHIPS AND NETWORKS
Part of IVL's strategy is to maintain and develop close cooperation with the business sector, international research bodies and universities. As a result, IVL plays an active role in several international research networks and other partnerships. In Sweden, IVL cooperates closely with the Chalmers University of Technology in Gothenburg, and KTH, the Swedish Royal Institute of Technology in Stockholm.

LABORATORIES AND TEST CENTRES
IVL operates its own laboratories for advanced chemical analysis – both organic and inorganic – and an experimental facility where new technology for more resource-efficient production is developed. With KTH, IVL jointly operates Hammarby Sjöstadsverk, a unique testing and pilot facility in advanced water treatment technology.

ENVIRONMENT AND QUALITY
IVL is engaged in environmental and quality management, as well as in work environment issues within the scope of an integrated management system. The system has been environment and quality certified under ISO 14001 and ISO 9001.

CONTENTS

THE 50-YEAR OLD WHO IS LOOKING AHEAD

Telling the future is hard and it's gotten even harder. What was once considered unlikely has become a reality and the traditional forecast methods and models need to be revised. How should we handle this as a successful research institute? What will development in the environmental and sustainability field look like in the next five to ten years? The systematic market analysis that we've done for the past few years gives us valuable information, but we have to continue translating it into concrete plans and activities.

Management guru Philip Kotler said that there are three kinds of companies. Those that make things happen, those that watch things happen and those that wondered what happened. As the CEO of IVL Swedish Environmental Research Institute, I have a responsibility to make sure that we belong to the first category both today and tomorrow. Making science reality and ensuring that the latest research is put to use in companies and society at large are some of our most important tasks.
Our annual report for 2016 contains a bit about our 50th anniversary, as well as quite a few other sections worth reading covering everything from the Internet of Things and environmental weather to ascidians.

We strengthened our expertise in a number of areas, such as mobility. Our cooperation with Chinese authorities, businesses and organisations also celebrated a 30-year anniversary in 2016, which you can read more about a few pages down.

The issues of climate and sustainability have shifted from being isolated components to becoming an integrated part of business operations and this is also true for IVL. Consequently, we are strengthening our internal sustainability efforts and beginning with 2016, we will provide a sustainability report in accordance with the Global Reporting Initiative's (GRI) guidelines. We are continuing to grow and in order to remain successful, we must continuously follow up on the added value we create for our customers, and the ways in which we contribute to a sustainable society. The 2016 customer interviews continue to depict a very positive image of IVL as a professional and key partner and contractor. But it's always possible to do a little bit better, so I repeat last year's encouragement of the readers of our annual report, our customers and partners, to give us feedback on the work we do, on our sustainability efforts, and how successful we are in documenting them. Feel free to email us at sustainability@ivl.se.

Enjoy your reading!

TORD SVEDBERG CEO

Cover photo: Anna Fråne **Photo:** Jonas Tobin

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TORD SVEDBERG

OUR CONTRIBUTION TO ENVIRONMENTAL DEVELOPMENT IS EVER MORE IMPORTANT

It was a very cold start to 1966. The lowest temperature in Sweden to-date was measured at Vuoggatjålme, 53 degrees below zero. It was warmer in July and England won the World Cup final in football. A few months later, the Essingeleden by-pass in Stockholm was inaugurated and in November that same year, the new Älvsborgsbron bridge in Gothenburg was inaugurated by the Minister for Communication, Olof Palme. That same year, a well-formed environmental institute was born that is known today as IVL Swedish Environmental Research Institute (IVL).

IVL came about through a discussion and agreement between the Swedish government and Swedish industry. The two people who signed the agreement were the consulting cabinet minister at the time, Olof Palme, and the Director at the time of the Federation of Swedish Industries, Axel Iveroth.

In a safe at IVL, there's a copy of a letter from Olof Palme to Axel Iveroth where Palme expresses the need for coordination in issues concerning water and air conservation.

The letter is signed "With heartfelt greetings, Yours sincerely Olof Palme". I believe that such closing words are now very rare in correspondence between the government and enterprise.

At the end of the letter, Palme writes: "My answer has unfortunately been somewhat delayed. This is due to the difficulty in figuring out which bodies and agencies are active in this area."

This note of his is interesting. Because, 50 years ago, there was no coordinated environmental research. What made it difficult to obtain an overview was the fact that research was so fragmented.

Today, it can also be hard to get an overview, but it's mostly because there are so many actors involved in the environmental field. But there are few if any who have the breadth and continuity that the IVL Swedish Environmental Research Institute has. We have expertise and experience in both leading large, multi-year projects in the climate field and running very concrete and applied projects, an example of which was our contribution to the clean-up work that was done after the mail plane that crashed in the mountains of northern Lapland in the winter of 2015.

When we look back – what results can we see from our environmental efforts in the first 50 years of our existence? There's no doubt that the environmental situation has improved significantly in many areas. The air quality in our cities has improved as has the water quality in our rivers, lakes and streams. IVL's operations have very actively contributed to this development.

Both the state of the environment and the view of the environment and environmental issues have improved. Many of the gloomy prophesies that were driven by environmental commentators in the 1960s and 1970s never happened and the outlook is now more positive. Today, we have Swedish environmental quality goals and a number of conventions that set out the direction of the continued environmental efforts.

"One of IVL's strengths is that we constantly work to develop and renew our activities."

One of IVL's strengths is that we constantly work to develop and renew our activities. For 50 years, we have kept with the times, broadened our offering and continuously developed new knowledge and applied solutions.

The fact that we work with applied research is another one of our strengths. We disseminate knowledge and make science a reality, in contrast to many others who get bogged down in discussing problems and debating, never able to make things happen. In other words, we make sure that the latest research is put to practical use in businesses and society in general.

“Although the state of the environment has improved radically, there’s a lot left to do”

The fact that our operations are relevant and our services in demand is confirmed by our turnover for 2016, which increased by around 7 per cent compared with the previous year and by a full 50 per cent compared with six years ago.

Our annual customer interviews continue to depict a positive picture of IVL, including comments that we listen, have a good reputation and possess unique expertise. The interviews also give us feedback on what we can improve, such as the ability to handle changes in project management and to formulate customised and easy-to-read reports.

During the year, we broadened and strengthened our expertise through a number of recruitments and we carried out one acquisition in the biogas area. We also took over a number of employees from one of our customers and thereby strengthened our expertise in such areas as chemicals management, life-cycle analysis, sustainable production, sustainable products and environmental management.

We continued to be very visible in the media and have clearly exceeded our goal for the number of published scientific articles.

Costs associated with our anniversary, our growth and a lower chargeability ratio have, however, had a negative impact on our operating profit. In 2017, we need to take steps to return to a profit level in line with, or better than, what we achieved in earlier years.

Work was begun on a number of new processes in 2016. As a part of strengthening our internal sustainability work, we will begin reporting in accordance with the Global Reporting Initiative’s (GRI) guidelines this year. We also initiated work to obtain recertification with new ISO standards for quality and environmental management.

IVL has extensive international activities with Europe as our home market. During the year, we had 33 on-going and seven new EU projects, which is a high number considering our size. Otherwise, focus is on China and India. By being an actor in Team Sweden, we contribute to supporting Sweden’s export strategy and strengthening the competitiveness of Swedish companies in the international market.

In 1899, the head of the U.S. Patent Office, Charles H. Duell, is said to have noted that “Everything that can be invented has been invented so we might as well shut down the Patent Office”.

Although the state of the environment has improved radically, there’s a lot left to do, both in Sweden and internationally.

I can therefore assure you that I won’t suggest that IVL be shut down, but rather I confidently look to a future where we continue to contribute to development in the environmental field both in Sweden and internationally. There are still many challenges and problems where we can contribute our expertise and applied solutions. To quote Alf Henriksson, one of our best authors in my opinion, who wrote:

“When dissatisfaction subsides, progress comes to an end. When happiness is achieved, energy wanes. But it’s a long way there, as we know. We can count on an eternity of progress.”

So there is a great deal left for IVL to continue working on. Together with you, our customers, partners and employees, we will continue the journey towards our vision – a sustainable society.

1966 – 2016 IVL CELEBRATES 50 YEARS

In 2016, it was 50 years ago that the Swedish government and Swedish industry joined forces to establish Sweden's first environmental research institute – IVL Swedish Environmental Research Institute. Back then, people already realised that the environment was something that demanded wide-ranging efforts from both the public and private sectors, and this collaboration has since formed the basis for IVL's operations.

On the following pages, you can see some milestones from IVL's 50-year journey from the 1960s – the age of environmental surveys and clean-ups – to today when we speak of sustainable consumption, social sustainability and a circular economy. The environmental problems have gone from being mainly local to being global and requiring global solutions. IVL has kept pace with development and works in the international arena today.

More about our history can be found at www.ivl.se

On 25 October, IVL celebrated 50 years with an anniversary conference at the Chinese Theatre. Those pictured include IVL employees Joakim Hållén, Jan-Olov Sundqvist, Eva Bingel, Jeanette Green, Gao Si and Anna Jarnehammar.

Photos: Anette Andersson

FIRST WATER THEN AIR

1

In IVL's early years, activities were focused mainly on phosphates in laundry detergent, chemical and biological precipitates from wastewater, the development of analysis methods, mercury emissions and steps to reduce them. A few years after IVL's founding, research began on air quality issues and it was almost immediately placed in Gothenburg where it came to be led by Professor Cyrill Brosset.

ALLOWED INTO THE FACTORIES

The agreement on cooperation and insight meant that IVL was allowed into the factories, something that had been absolutely unheard of before, and definitely had not occurred anywhere else in the world. In through the gates, where they ended up straight in production and especially right out into the drains and smokestacks.

2

OUR TIMELINE

1960S

IN THE BEGINNING, THERE WERE TWO IVLS

3

When IVL was founded, two new organisations were created – the Institute for Water and Air Conservation Research and the company Industrins Vatten- och Luftvård AB, both of which had the abbreviation IVL in Swedish. They shared a common direction and management, as well as administrative functions and laboratories. The point of creating two new organisations with close ties was that the institute IVL would conduct research activities and develop new knowledge while the company IVL would then quickly transfer the research findings to industry. Over time, having double IVLs became impractical and since 1980, there has only been one IVL.

4

OWNERSHIP STRUCTURE AND FINANCING

The Institute for Water and Air Conservation Research (IVL) was founded through an agreement between the Swedish government and an industry federation in October 1965. Through the agreement, the government and the industry federation committed to each contribute half of the financing for IVL's operations. The first agreement period ran to the end of December 1970 and the total funding was just over SEK 1 million per year.

20 EMPLOYEES IN 1966

The number of employees at IVL grew steadily from 20 to 177 all the way to the mid-1980s when IVL underwent a difficult crisis and the number of employees decreased. The next crisis occurred in 1993 when the forest industry cut its research grants. There has since been a steady recovery and the number of employees was just over 270 in 2016.

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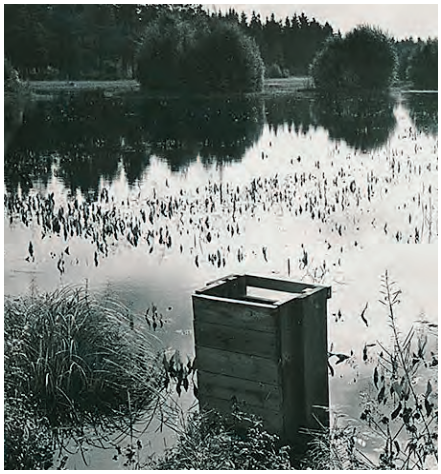

FIRST RESEARCH STATION

In July 1975, IVL opened its first research station. It was located in Aneboda in the Småland region of Sweden through a donation by a fish-breeding facility. In 1978 and 1980, research stations were inaugurated in Fryksta and Karlskrona.

6

7

SAVE THE STORK PROJECT

One of IVL's stranger projects involved reintroducing the extinct Swedish strain of stork. The storks were picked up by air from Switzerland and placed at the research station in Aneboda. Eventually, the storks were moved to the Stork Project in Skåne, which is operated by the Swedish Society for Nature Conservation.

10

IVL BECOMES A LIMITED LIABILITY COMPANY

In 1982, IVL was reorganised as a limited liability company and was the first among the research institutes to become a corporation. All of the shares in IVL Swedish Environmental Research Institute are now owned by the Foundation Institute for Water and Air Research (SIVL) with the Swedish government and Swedish enterprise as stakeholders.

1970S

1980S

9

INDUSTRY-WIDE RESEARCH

The forest industry founded the Swedish Forest Industries' Water and Air Pollution Research Foundation (SSVL) in 1970. SSVL projects have engaged many IVL employees over the years and still do so today. Together with experts from other institutes and industry, work has been done to reduce emissions from the forest industry. Among other things, the effects have been studied of chlorine gas bleaching on fish.

8

IMPORTANT MEETING PLACE FOR REPRESENTATIVES OF THE ENVIRONMENT AND INDUSTRY

Ever since the beginning, IVL's role as the neutral meeting place for business, authorities and researchers has been important. The regularly recurring IVL conferences, most often attended by King Carl Gustaf XVI, have partly served the function as an arena for meeting. At the conferences, new research reports from IVL were presented and discussed.

"What was interesting was that we who came from industry gained shared knowledge of the state of the environment and what should be done," says Lars-Göran Bergquist, former environmental manager at Astra who attended virtually every conference.

12

TRYING TIMES IN THE 1980S

In connection with the reorganisation into a limited liability company in 1982, major losses were discovered. This led to trying times with poor finances and a lack of confidence from the principals. Between 1982 and 1985, the number of employees decreased from 200 to 130 people. The research stations in Fryksta and Karlskrona were also closed.

WORLD'S FIRST INDOOR PCB DECONTAMINATION

In September 1981, three IVL employees put on fully sealed white protective suits and took the first steps into the Stockholm Energiverk power plant at Danvikstull. They then began the first major PCB decontamination in history.

11

A NEW NAME FOR AN OLD INSTITUTE

After 33 years as the Institute for Water and Air Conservation Research (IVL), the environmental issues had become so broad that it was time to change names. Since 1999, the company name has been IVL Swedish Environmental Research Institute.

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NATIONAL ECONOMIC BENEFIT OF SCRAPPING OLD CARS

In 1991, IVL conducted a study on behalf of the Environmental Commission of Skandia, which showed that a significant societal gain would be made if older cars without catalytic converters were scrapped early. The value of the environmental gains was estimated at SEK 6,000 per vehicle scrapped at around ten years of age.

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A DEVASTATING FIRE

One Sunday in May 1998, a spark arose at a refrigerator under a dusty counter in IVL's laboratory in Kortedala outside Gothenburg. A gas chromatograph was on the counter and above the gas cylinder, there was a hydrogen gas line. The explosive fire that arose was so intense that metre-high flames billowed from the windows when the fire brigade arrived on scene. The fire destroyed most of IVL's organic laboratory in Gothenburg and there was smoke damage to the entire office. Everything had to be decontaminated. But against all odds, new analysis instruments were in place in the temporary laboratory in the office's gym hall just two months later. And when operations began rolling again, it was confirmed that not one single order had disappeared; everything was able to be delivered to the customers although slightly delayed.

1990S

13

POLITICIANS WERE INTERESTED

In the first 30-40 years of IVL's operations, the politicians were very interested in IVL's research. Ingvar Carlsson was one of them. In January 1986, he visited IVL's sampling station at Rörvik and was guided by IVL's Peringe Grennfelt. At the time, Ingvar Carlsson was the Minister of Future Issues with responsibility for research matters. Almost exactly one month after his visit, Olof Palme was murdered and Ingvar Carlsson became the Prime Minister.

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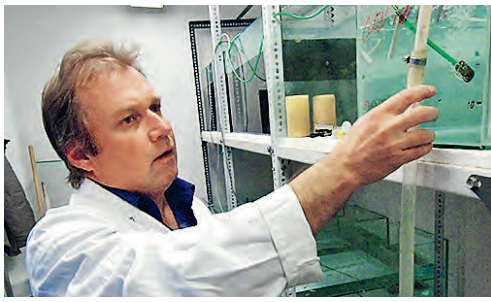
ENVIRONMENTALLY ADAPTED CAR WASHES

In one project, IVL investigated the possibilities of using separation techniques to reduce emissions from car washes. The aim was to remove all pollutants from the wastewater, meaning detergents, asphalt dust, heavy metals, grease, petrol and oil. The goal, which was achieved, was that the water would be able to be reused.



TOMAS AND THE ZEBRAFISH – A MILESTONE FOR THE ENVIRONMENT

In March 1992, the last tank of chlorine gas was emptied at the pulp mill in Skutskär. After claiming for many years that chlorine bleaching was necessary, the pulp industry turned and began investing in alternative methods. Tomas Viktor's tests on zebrafish played a major role in the industry's decision. The test method he developed at IVL is a world standard today.
"When we showed the environmental problems that arose, we first met with resistance, but gradually the technology was developed and the factories were converted and optimised," says Tomas Viktor.

18

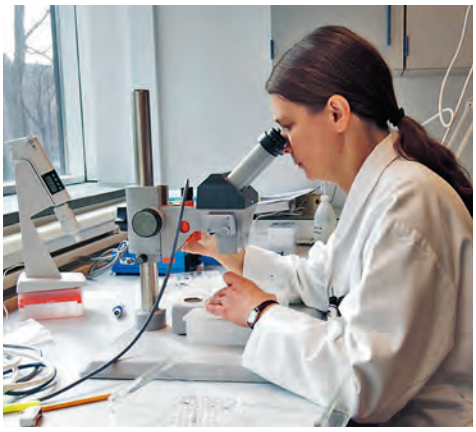
2000s

EU WATER FRAMEWORK DIRECTIVE ENGAGES IVL

Many people at IVL were occupied with the EU Water Framework Directive in the 2000s. The directive, which entails stronger protection for both the marine water environment and the fresh water environment, sets high quality requirements on data, national reporting and programmes of measures.

Among other things, IVL developed the tool Watshman, which aims to manage information at the local level on water quality, emissions to the water environment and models for estimating the total burden on the water environment by human activities.

19



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NEW ANALYSIS METHODS

At the beginning of the 2000s, the operations in specialist organic analysis are expanded to be able to monitor the environmental quality goal of a "Toxin-free environment" and the EU's chemicals strategy. New analysis methods were developed to monitor EU directives and the laboratory expanded its analysis programme to cover most chemicals prioritised in the EU Water Framework Directive.

IVL IS GROWING IN SYSTEM ANALYSIS

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Through the acquisition of the operations in CIT Ekologik in the mid-2000s, IVL increases its already extensive expertise in system analyses and above all life-cycle assessment (LCA), method development of LCA and development of decision support, product development and environmental communication associated with LCA. CIT's expertise in socio-economic analyses is important for strengthening IVL's environmental economic expertise in times when economic aspects must increasingly be connected to environmental measures.

LEACHING IN THE WAKE OF THE STORM GUDRUN

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After the storm Gudrun in January 2005, IVL was commissioned by the Swedish EPA and the Swedish Forest Agency to investigate how great the risks were for higher leaching of nitrogen and methyl mercury as a result of the clearings and the large amount of uprooted trees. The calculations indicated that the leaching of both nitrogen and mercury increased throughout the Götaland region, by more than 100 per cent in the most severely storm-struck areas.

40-YEAR ANNIVERSARY

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IVL turned 40, which was celebrated with an anniversary seminar on 23 May in the presence of His Majesty the King and around 550 participants from business, the government and public agencies. One of the main points at the seminar was a future vision "How we solved the energy crisis and got rid of the dependence on oil", which was prepared by IVL's researchers. The vision was commented by a long list of representatives from the business and political spheres. The seminar was broadcast in its entirety on multiple occasions in the Swedish public service channels, SVT.

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IVL MOVES IN TO CAMPUS

In 2004, IVL's Gothenburg office moved into new premises adjacent to the campus of Chalmers University of Technology in Gothenburg. In Stockholm, a move is made in 2005 to the old library of the KTH Royal Institute of Technology, which was converted to suit IVL's operations.

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KEMIGUIDEN CHEMICALS GUIDE

In 2003, IVL's first interactive, web-based tool was developed – KemiGuiden chemicals guide, which can be used for free as a support in chemicals work at the workplace. KemiGuiden is an aid to figure out which laws and regulations in the chemistry area apply for a workplace, and it also provides tips on how to fulfil the rules.

EMISSION TRADING AND FINANCIAL INCENTIVES

IVL's climate research actually began in 1989 with a survey of Sweden's collective carbon dioxide emissions. Piece by piece, the operations grew with a focus on emission trading and financial incentives. With the backing of SEK 100 million, IVL conducted the climate policy research programme Clipore in 2004-2011 and the climate issue has since been integrated into the majority of IVL's research.

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TEST OF INDIVIDUAL CLIMATE IMPACT

IVL has developed a service called the Climate Account. Here, private individuals can test their climate impact from travel, food and housing. At Klimatkontot.se, there is also information on how to reduce one's greenhouse gas emissions, as well as what impact incentives have on society's greenhouse gas emissions. Test results can also be compared with the average Swedish resident or the world citizen and what emission level corresponds to sustainable development.

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AUTOMATED SORTING SHOULD INCREASE TEXTILE RECYCLING

Every year, 4.3 million tonnes of textile waste is sent to landfills or incinerated in the EU. More than 120,000 tonnes new textiles are put on the Swedish market, but only 5 per cent of the material is recycled. This is far too little in the opinion of IVL, which together with a number of actors aims to develop and test automated sorting for high-quality textile recycling.

"The idea is to create a sorting solution that's adapted to the textile recyclers' and textile companies' needs and thereby become the link that is missing today between textile collection and high-quality textile recycling," says Maria Elander who is one of IVL's waste researchers.

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2010S

PUMP CAN OXYGENATE DEAD OCEAN FLOORS

Two years of practical trials in the EU-funded WEBAP project indicate that it is possible to use a wave-operated pump to drive down oxygen-rich surface water to restore dead ocean floors. The technology, which imitates a natural process, has proved capable of pumping down large volumes of water and can be adapted to a variety of conditions. The trials were conducted in Hanöbukten and Kanholmsfjärden in the Stockholm archipelago.

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A LARGE NUMBER OF ENVIRONMENTAL TOXINS IN SEABIRD EGGS

On behalf of the Norwegian Environment Agency, IVL analysed seabird eggs collected on islands off the north Norwegian coast – islands that should be affected very little by environmental toxins. The eggs proved to contain all of 158 different chemical substances, including totally new environmental toxins – some of which had been intended as preferable alternatives to recently prohibited chemical substances – including new flame retardants.

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IVL CELEBRATES 50 YEARS WITH PICTURES OF THE FUTURE

Photo: Anette Andersson

The environment has improved in the past 50 years. This was confirmed when IVL Swedish Environmental Research Institute celebrated 50 years with an anniversary conference at the Chinese Theatre on 25 October. The conference offered a look back over a long and often successful environmental effort. But the spotlight was nonetheless directed forward.

Through four different pictures of the future, IVL's employees sketched out what the world may look like in 25-35 years. By then, the last combustion engine will have long been phased out. The vehicle fleet will be electric and self-driving, and a steering wheel ban will even be enacted in 2035. Extremely few will own their cars, and travel by car will instead be a service provided on a subscription basis. We will own, however, our own electricity generation and sell the surplus through automatic grid services.

"We will become prosumers, both consumers as well as producers of products and services. And this is true not only of us as private individuals, but also of larger energy users. As a part of a circular society, it is only natural," explained Mathias Gustavsson, one of several IVL colleagues who presented various views of the future. We will also have a sustainability index to relate to as a tool for measuring the actual social and environmental costs of goods and services.

"When it comes to material welfare, adequacy will be the norm in 2041"

Digital development will also revolutionise daily life. Most of us will work less. Time will become a resource just as important as money. The value of ownership will be renegotiated. We will share with one another and reuse things.

"When it comes to material welfare, adequacy will be the norm in 2041," said Åsa Moberg.

A fourth scenario sketched out how IVL's long activities in China will contribute to the Chinese taking the lead in the global environmental efforts. This was presented by Östen Ekengren, Executive Vice President of IVL, and Gao Si, Head of IVL's Chinese office.

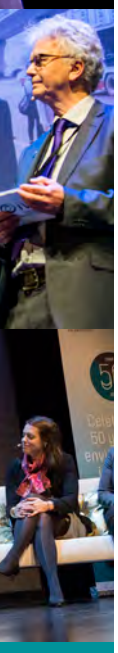
In 2050, China's environmental problems will have been solved since the central government will have made major investments in green innovations and more stringent rules and laws. This is what the prospect holds.

"China is a large country that has the strength to act. This was apparent not least during the financial crisis. But Sweden is a country with extensive know-how that can influence China," said Gao Si.

TOP PICTURE Åsa Stenmarck and Louise Staffas. MIDDLE PICTURE Gao Si and Östen Ekengren. PANEL DEBATE WITH: Svante Axelsson, Coordinator, Fossil-free Sweden, Helle Herk-Hansen, Environmental Manager, Vattenfall, Urban Wästljung, Scania, and Karin Comstedt Webb, Sustainability Manager at Cementa.

USEFUL RESEARCH FOR 50 YEARS

At IVL's anniversary conference, four pictures of the future were presented by IVL's employees. They tell of a society that has undergone major changes, where the environment and sustainability are cornerstones.



JOHN MUNTHE
/ Vice President of Research, IVL Swedish Environmental Research Institute

The transformation has not only been driven by technical innovations – even if they play an important role – but also by novel thinking in terms of the government's incentive work and how we citizens consume, travel and live our lives. To get there, we need to undergo a process of change that we today cannot fully see the consequences of. The prospective pictures' most important task is to paint a positive view where we see the results of this change process – not how we implemented it.

We are already facing a number of social changes that will demand both novel thinking and innovation, including the transition to a circular economy, growth in our forest-based bio economy and the transformation into a climate-neutral country. The change work in this direction is already under way in many parts of society – enterprise has long focused on reducing energy and resource consumption and we have many laws and incentives that set limits and encourage sustainable development.

Applied research and development will play a major role in the continued change-over to a sustainable society. Looking back on IVL's early years, the activities were largely focused on solving concrete environmental problems, such as those concerning local emissions to water and air, and old sins that polluted soil. Technical solutions needed to be developed and tested to then be able to be used directly. IVL also worked early on to build knowledge about, for example, air pollution, how it was transported and what its effects were. This research was also applied, but the road from studies and measurements to the introduction of solutions was different and could involve convincing our neighbouring countries that measures against air pollution were necessary by presenting knowledge and examples.

"We are already facing a number of social changes that will demand both novel thinking and innovation"

The change work is under way and many steps have already been taken by companies, agencies and individuals who contribute to greater resource and energy conservation. Ahead of us are larger transformative steps where innovation and research will play a crucial role. We can already see that conflicting goals will arise that have to be resolved. This may be conflicts between resource management and the environmental goal of a toxin-free environment, or between greater use of forest raw materials and the protection of biological diversity and natural assets. Th major transformations that await fossil-dependent sectors, such as transportation and parts of the materials industry, may entail conflicting goals, not least with regard to financial goals for individual companies and industries.

For applied research, demand will grow for developing solutions that give rise to conflicting goals to the least extent possible. Seriously conflicting goals are often accompanied by a polarised debate where different actors prioritise and argue for the societal goals closest to their activities and interests. The polarised debate is often built on different interpretations of the state of knowledge and based on different values. To create a foundation for a constructive dialogue on conflicting goals and considerations between different interests, a common base of knowledge is necessary. Here, the research plays an important role to stand for independent knowledge and to support a fact-based dialogue.

IVL's broad expertise and long experience of collaboration with companies, agencies and organisations, both nationally and internationally, makes us well equipped to contribute knowledge and concrete solutions that support the transition to a resource-efficient and climate-neutral society.

IVL'S OPERATIONS CONTRIBUTE TO SUSTAINABLE SOCIAL DEVELOPMENT

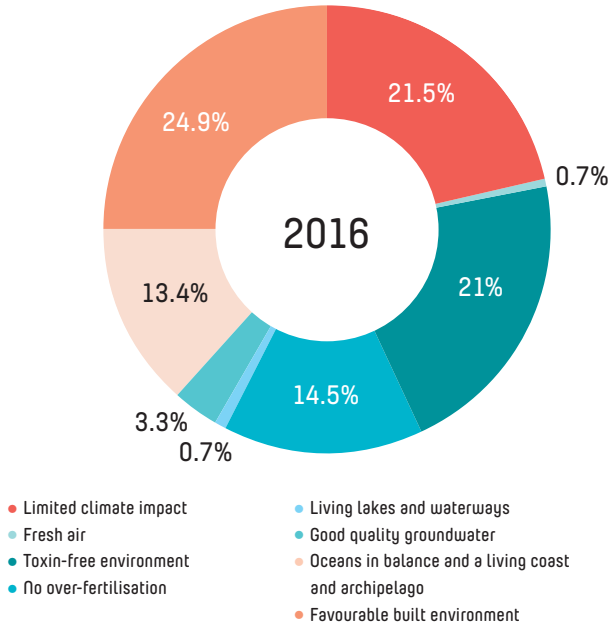
Today, the world is facing major challenges of which climate changes, water shortages, air pollution, growing problems with waste and rapid urbanisation are just a few examples.

The UN has set global sustainable development goals and IVL has the ambition of contributing to the fulfilment of both these and Sweden's national environmental goals.

IVL's activities cover the entire sustainability field and extend across all industries and organisations of society. With the applied research and consultancy activities, IVL can make positive contributions to more sustainable social development.

BROAD INTERDISCIPLINARY EXPERTISE

Since the beginning, IVL has developed to meet current needs for solutions to sustainability-related problems. The applied research and development is conducted in close collaboration between the public and private sector.



The consulting projects build on scientific foundations and the research is characterised by an interdisciplinary approach and systematic thinking, something that is necessary to address today's complex challenges.

Today, IVL's research and professional services focus on everything from the mapping of environmental issues to solutions and preventive measures, including economic and social aspects.

COLLABORATION AND ALLIANCES ACROSS BORDERS

IVL's role is to act as a bridge builder between the research and business communities, and to create arenas of interaction between different social actors. The strategy encompasses maintaining and developing close cooperation with the business community, research bodies and universities.

Europe is IVL's home market, but we also have operations in the rest of the world. Particular focus is on China, where we have our own operations, and India. We also successfully participate in EU-funded research projects in the fields that are relevant to Swedish society and thereby build up networks and expertise from an international perspective.

IVL SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE

contributes to achieving national and global environmental and sustainability goals. We have categorised all R&D projects that are co-funded by the government and enterprise based on which national environmental goals the projects address. In 2016, IVL has had the most impact on the goals of a limited climate impact, a toxin-free environment, a favourable built environment and no over-fertilisation.

The figure to the left presents which environmental goals the co-funded research contributed to achieving during the year.

IVL's researchers in Lysekil measure the levels of microscopic debris in the water along the west coast of Sweden. An overall objective of the research is to obtain data that provides input for developing effective decontamination technologies. Photo: Anette Andersson

OBJECTIVE, VISION AND BUSINESS CONCEPT

OBJECTIVE

IVL Swedish Environmental Research Institute conducts applied research and consulting projects aimed at promoting ecologically, economically and socially sustainable growth in the business sector and the rest of society.

VISION

Our vision is the sustainable society. We drive the transition to a sustainable society by transforming:

- science into reality
- environmental problems into opportunities
- linear processes into a circular economy

BUSINESS CONCEPT

IVL Swedish Environmental Research Institute enables ecologically, economically and socially sustainable growth in business and the rest of society by providing applied research and professional services.

Through its business model and its operations, the company contributes to strengthening Swedish competitiveness and supports companies and government agencies in their sustainability work to solve specific environmental problems in a national and international arena.

CORE VALUES

Our core values are credibility, foresight and a holistic approach. As employees, we are committed and do work that benefits society and our customers.

DIALOGUE ABOUT WHAT'S IMPORTANT

In order to be up-to-date on the needs of all stakeholders, IVL conducts a continuous dialogue with employees, customers, suppliers, the Board and owners, partners, trade associations, politicians and authorities; these groups are also identified as IVL's most important stakeholders.

Since IVL's prime objective is to promote sustainable development, it is essential that we cooperate with the key players in the environmental and sustainability field. In the past year, this cooperation was mainly conducted in four operational councils, which are thematically focused. They are: *Natural resources, climate & environment, Resource-efficient recycling & consumption, Sustainable production & environmental technology* and *Sustainable urban development & transport.* Within the operational councils, IVL gathers stakeholders from various groups, such as customers, authorities, owners and partners.

The operational councils serve the dual purpose of identifying future research needs and presenting noteworthy outcomes of ongoing IVL R&D projects. The operational councils discuss such matters as market and world issues, general needs of certain industries, new project ideas and the development of IVL's research agenda.

SPECIAL ACTIVITIES IN 2016

To get a better idea of what sustainability areas IVL's stakeholder believe are the most important, we also conducted a web-based survey during the year. In the survey, the respondents had the opportunity to rank various pre-defined sustainability aspects based on importance. They also had the opportunity to highlight additional issues that were not already defined in the list of sustainability aspects. The survey was sent out to all employees, the members of the respective operational councils and the boards. The dialogue with IVL's stakeholders in the company's different channels, together with the responses from the survey and customer interviews, formed the basis for which aspects are highlighted in the sustainability reporting.

PLANNED ACTIVITIES

Stakeholder dialogues will be conducted every year to ensure that relevant sustainability aspects are included in the reporting. In 2017, a plan for future stakeholder dialogues will be prepared.

STAKEHOLDER GROUP	COMMUNICATION CHANNEL	MOST IMPORTANT SUSTAINABILITY ASPECTS FOR THE STAKEHOLDER GROUP
Employees	• Internal information forums • Employee survey • Employee talks	• Competence and management development • Ethics and integrity • Work environment, health and safety
Customers	• Customer interviews • Satisfied customer index • IVL's operational council	• Customer value • Work environment, health and safety • Competence and management development • Energy use • Sustainability requirements on suppliers/partners
Board and owners	• Board meetings	• Work environment, health and safety • Gender equality, equal opportunity and diversity • Customer value
General public, local community and trade associations	• Media and press • Website	• In 2016, no targeted activities were conducted
Politicians and authorities	• Regular meetings with ministries and agency representatives • IVL's operational council	• Customer value • Competence and management development • Sustainability requirements on suppliers/partners
Suppliers and partners	• Regular meetings and annual compilation of collaborative formats	• Customer value • Competence and management development • Sustainability requirements on suppliers/partners

MATERIALITY ANALYSIS

The results from the questionnaire survey and the interviews held during the year form the core of IVL's materiality analysis and the reporting according to GRI G4. The materiality analysis was done in a working group consisting of IVL's management group an other key representatives in the organisation. The areas identified in the stakeholder dialogue were evaluated and a prioritisation was done based on both IVL's influence and the stakeholder expectations.

The materiality analysis resulted in IVL defining five key areas that are to be reported for 2016. These areas will be followed up annually to ensure that IVL focuses on relevant issues, in line with the stakeholders' wishes and expectations. The consistently most important aspect is how the operations contribute to sustainable social development, which is also the foundation of IVL's vision.

FOCUS ON THE MOST IMPORTANT

The stakeholder dialogue and the materiality analysis have resulted in a number of aspects that the 2016 report is based on.

- Customer and environmental benefit
- Work environment, health and safety
- Gender equality, equal opportunity and diversity
- Competence and management development
- Ethics and integrity

ENVIRONMENTAL BENEFIT AND SATISFIED CUSTOMERS

For IVL, it is absolutely crucial to be able to deliver research and consulting services that benefit enterprise and society in the transition to a reduced climate and environmental impact and for greater resource efficiency and sustainability. This is how we achieve our vision.

To create benefit for the customers and society at large, it is important that what IVL delivers maintains a high level of quality. To ensure this, we conduct project evaluations and customer surveys. Among other things, an annual interview survey is done among some 20 customers in various industries to investigate their opinion of IVL as a supplier and of the quality of what is delivered.

We set targets every year to constantly improve customer benefit, which we measure in a satisfied customer index.

EXPANDED CUSTOMER SURVEY IN 2016

The customer survey carried out in 2016 provided a high rating, which resulted in a satisfied customer index of 4.3 on a five-point scale.

The survey shows that all respondents would consider engaging/cooperating with IVL again and would also recommend IVL to others. In addition, it came forth that the main reasons that they chose to engage IVL were previous positive experiences of cooperating with IVL, IVL's unique expertise and IVL's strong reputation.

In 2016, in addition to the ordinary customer survey, we carried out a more extensive investigation to study how we can improve and clarify our offering and make IVL's services even more useful.

CHALLENGES AND PLANS FOR THE FUTURE

Our customers demand solutions that are on the cutting edge of research and science, which sets high standards on expertise, as well as sensitivity to the customer's needs and good communication to ensure involvement and thereby a quality-assured result.

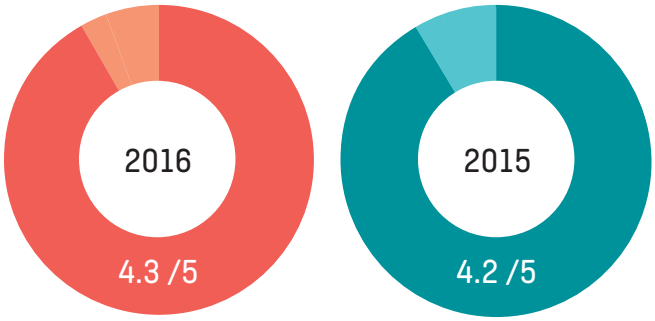
In 2017, we are planning for activities to address the improvement areas pointed out by the participants in the customer survey. Among them are continued focus on customer benefit through a more efficient project process and developed reporting of the results.

We will also continue with the annual customer follow-ups.

ENVIRONMENTAL BENEFIT OF IVL'S WORK

The products and results we provide to the customer are also our absolutely most important environmental aspect. We have therefore developed a tool to assess the environmental benefit that our advice to the customers provides, on condition that they follow the advice. The ambition is that all projects that are concluded will be assessed based on seven environmental impact categories and a number of social and financial impact categories.

CUSTOMER SATISFACTION INDEX

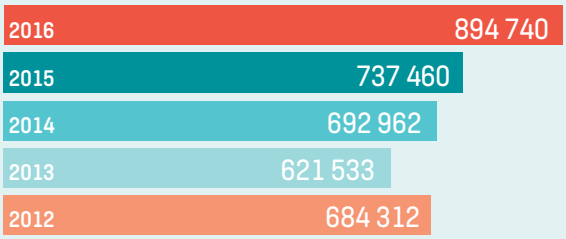


The tool has been used for a few years and consequently, its reliability and the basis for the assessments have increased. In 2016, 169 projects (146) were assessed and the index was 7.8 (7.2).

IVL follows up this assessment annually and has set the target of achieving above a collective index of 6.5, which means that at least one impact category is assessed to be of major significance.

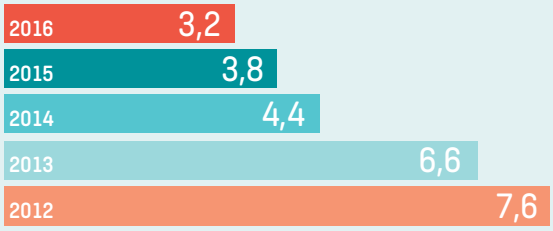
On pages 18 to 41, we present examples of projects that lead to both customer benefit and direct environmental benefit in society.

BUSINESS TRAVEL, RAIL (KM) DOMESTIC



Number of rail kilometres per employee increased by 11 per cent.

AIR TRAVEL INDEX, INTERNATIONAL

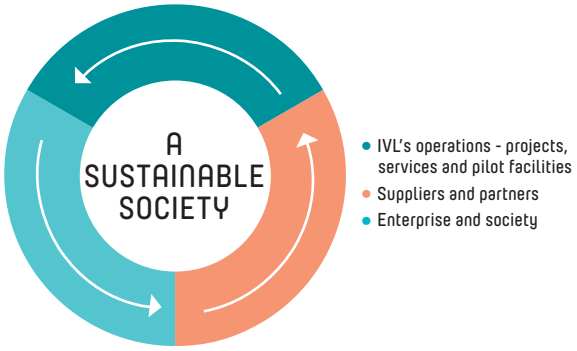


Environmental impact of international air travel counted as carbon dioxide emissions per SEK 1.00 earned.

HOW WE CREATE VALUE

IVL's value chain goes from suppliers and partners through the company's operations where competent and knowledgeable employees ensure to create environmental benefit and value at the customers.
IVL's main sustainability work primarily seeks to contribute to solutions that improve the environment and sustainability work in both the business community and society in general. To ensure that the right solution is developed, IVL also has to make sure to develop the right expertise and create a working atmosphere in its own organisation that makes it possible for projects and services to be formulated in a sustainable manner.

The value chain also includes deliveries to IVL's own offices, travel and materials to be able to carry out the projects. IVL guides internal operations towards sustainable purchases of materials and services.



INTERNAL ENVIRONMENTAL WORK

IVL's internal operations are to be conducted with the least environmental impact possible. We therefore work on environmental and quality issues within the scope of an integrated management system certified under ISO 14001 and ISO 9001. Goals are established and followed up via an established process within the management system. For purchases of chemicals and office supplies, the best alternative for the environment is chosen.
Our most significant environmental aspects are:

- advice to customers
- international business travel
- electricity and heating/cooling in premises

ENVIRONMENTAL IMPACT FROM TRAVEL

IVL's environmental impact through travel, calculated as carbon dioxide, decreased by 7 per cent compared with the previous year. International travel by air is an unavoidable aspect of operating internationally. IVL uses an index that measures environmental impact in the form of carbon dioxide emissions per SEK 1.00 earned. Over the five-year period 2012-2016, the index rating fell by 58 per cent. The total environmental impact from air travel has also decreased. National travel has increased, however.

During the year, IVL conducted a number of activities that entailed a greater need for travel. For example, two acquisitions entailed greater travel between the offices. The environmental impact from domestic air travel decreased by 5 per cent compared with 2012, but increased by 24 per cent compared with the previous year, 2015, which was a year of relatively low impact from travel. Domestic rail travel increased by 20 per cent in 2016.

IVL OFFSETS CARBON DIOXIDE EMISSIONS FROM EMISSIONS

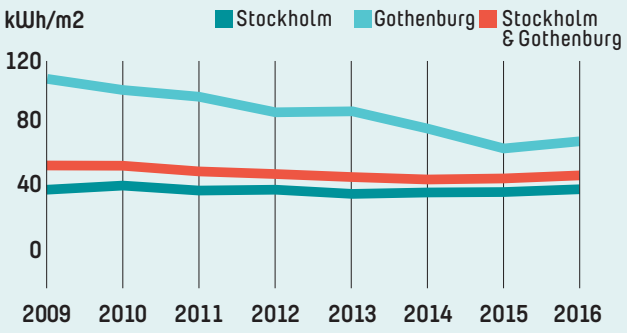
IVL has long had the goal of reducing the carbon dioxide emissions from business travel, in part by promoting video conferencing over physical internal meetings and rail travel over domestic air travel. Travel is often necessary, however, in order to conduct business and carry out the assignments.

IVL offsets for carbon dioxide emissions from business travel by allocating funds to a climate fund – *IVL's climate fund* – for activities and measures to reduce the climate impact of IVL's own operations and/or society in general. The fund was established in 2017 with compensation for emissions from IVL's business travel in 2016.

ENERGY USE

Energy use at the offices in Stockholm and Gothenburg increased by 5 per cent compared with 2015. Additional space was brought into use in 2016 to allow for the large number of new employees. Energy use per square metre has been relatively constant in the past five years.

ENERGY USE AT THE OFFICES



URGENT EFFORTS THAT MAKE A DIFFERENCE

Transport damage, fires, oil that leaks out or hazardous chemicals that are at risk of contaminating drinking water. When an accident happens and the environmental damage is a fact, it is important to be able to quickly make the right assessments and take action to minimise the damage and protect people and nature.

"When we come out to the accident scenes, the rescue services are often there. For us, it's important to quickly get an idea of what's happened and what needs to be done. Who and what are at risk of harm from the accident? We need to broaden our perspective from the actual scene of the damage and focus on what we don't want to happen – like chemical substances contaminating drinking water, and in such a case how it can be stopped."

These are the words of Johan Strandberg, one of IVL's environmental damage experts. IVL Swedish Environmental Research Institute has cooperated with the Swedish Fire Protection Association (SFPA) for several years. The SFPA has 11 specialised environmental residual value supervisors who are trained in how to handle environmental damages. When they are called out to an environmental damage site, they can consult with IVL's environmental damage experts when necessary, who help make assessments of what is reasonable and justifiable in terms of decontamination and other efforts. For IVL, this entails a kind of on-call service – the environmental experts are available to give advice by phone, but in the event of larger or more complicated events, they are also called out to the scene.

The environmental damage group at IVL consists of geologists, eco toxicologists, hydrologists, nature physical geography specialists and engineers. At IVL's laboratory, there are also chemists who help in sampling and analysis of soil and water samples from the accident scenes.

As early as the 1970s, IVL began to build up knowledge of the damage that transport accidents involving oil and chemicals can lead to in the ocean. This knowledge still comes to good use. At the same time, the knowledge has been developed about fighting and decontamination methods for oil and chemicals that come out into all soil and water environments. For example, IVL's experts were commissioned in March 2016 to lead the decontamination after a major diesel spill in Gällivare. Another accident occurred in northern Uppland where a fire truck drove off the road and tipped over. 450 litres of fire fighting foam with highly fluorinated compounds leaked out. Then it was important to quickly remove the source and make sure that the chemicals did not spread to the drinking water wells that were nearby.

Another dramatic event occurred in January when a mail plane crashed in the northern mountains of Lapland. Both of the pilots were killed in the crash and the plane was smashed into small pieces. At the crash site, a large crater was formed with a large amount of aviation kerosene that needed to be taken care of.

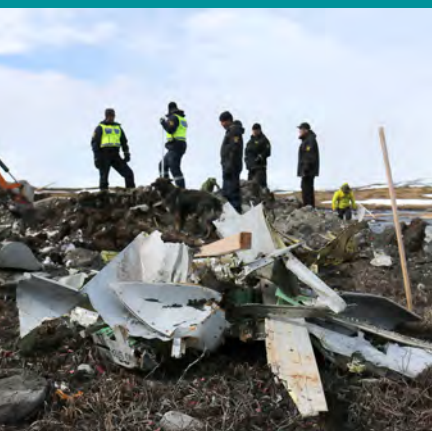
"We arrived at the scene after the National Board of Accident Investigation lifted their cordons. By then, the military had been there and picked up parts of the wreck. Roughly 2000 litres of aviation fuel had leaked out in the crash. It must have snowed at least half a metre since the accident happened so we couldn't really see the full scope of it. Samples showed that there was only a small part of the fuel that was still in the snow so we had to wait for the snow to melt before the clean-up work could begin," explains Johan Strandberg.

Johan Strandberg is one of IVL's environmental damage experts. He does assessments of what is reasonable and justifiable in terms of decontamination and other efforts.

“Roughly 2000 litres of aviation fuel had leaked out in the crash”

Erik Granerot from the Swedish National Property Board and Johan Strandberg, IVL Swedish Environmental Research Institute, on site in the northern mountains of Lapland. Photo: Mirja Palo

It was in January that the Norwegian mail plane crashed in the Lapland mountains. At the crash site, a large crater was formed with a lot of wreckage and aviation kerosene that needed to be taken care of.



An extensive clean-up effort was then conducted at the site of the crash. Wreckage, mail and polluted soil were loaded into tanks and flown out. In the sensitive mountain environment, everything had to be done by hand, by the military, rescue services and environmental damage experts. In total, 17 tonnes of debris were removed from the site, the smallest of which was collected with a vacuum cleaner. But the project is not yet finished. New soil and water samples will be taken in the area and the results will form the basis of future measures.

“In the sensitive mountain environment, everything had to be done by hand”

“Our projects often take several years after an accident has happened. Even if the acute phase is long since over, we continue with measurements and sampling to ensure that neither the environment nor people come to harm from the potential residual amounts of remaining pollutants.”

Johan Sandberg enjoys working in the environmental damage group. Out in the field, the processes are fast and every situation is unique. Even though there are often many actors involved in the clean-up work, the collaboration works well. Everyone in the municipality and at various agencies understand the importance of acting quickly, which means that these issues are prioritised. “The work we do can really make a difference, both in the acute phase and in the long term. By handling environmental damages responsibly, we can in the short term ensure to address problems as quickly and cost-effectively as possible, and in the long term avoid creating future environmental debts.”

The work out at the accident scenes can also create an interaction with the research since areas are discovered in the event of environmental damages that the researchers want to investigate more closely in the form of research projects. For example, IVL’s researchers are working in one project to develop more sensitive methods to detect oil remnants in water samples, in another to develop toxicity tests for new kinds of fuels like rape methyl ester and to investigate what happens if they end up in the water environment.

11 SUSTAINABLE CITIES AND COMMUNITIES

INTERNET OF THINGS TAKES ITS PLACE IN ENVIRONMENTAL RESEARCH

In a short period of time, our daily lives have begun to be filled with more and more online objects: activity armbands and solar cell panels send data about your health and optimise your electricity consumption. The same trends are now reaching environmental research. On the roof of the Nordstan shopping centre in Gothenburg, IVL is testing the digitised environmental monitoring of the future.

The wind is blowing at about five or six metres per second out of the west and the low pressure system is oppressive. Grey weather. But in the past week, the air was actually really clean with low levels of air pollution.

"Bad weather is often good environmental weather. When it's windy and rainy, the air is mixed about and the pollution levels are diluted and drop, especially nitrogen dioxide, which makes of the largest air pollution problem in Gothenburg. Still, cold days mean higher levels of nitrogen dioxide," says IVL's Karin Persson, who has worked on monitoring air pollution in urban environments since the 1990s.

On the roof of Nordstan 25 metres up, the traffic only sounds like a hiss. Here is the environmental administration's largest fixed measurement station of air pollution. Here, measurements have been taken of the concentration of particulates, nitrogen oxides, carbon monoxide, ozone and sulphur dioxide, every hour for 30 years. For the past few months, three new boxes have been attached to a railing and draw in air. They measure the day's environmental weather.

"They are online sensors that measure levels of particulates, nitrogen dioxides and noise, in real time with directly visualised levels on the web. They are less exact than established measurement instruments, but significantly less expensive and easier to set out at more locations to give a supplemental view of the air quality in the city," explains Fredrik Hallgren, Project Manager for the Vinnova-funded project Environmental Weather.

Environmental Weather is a so-called IoT project. The Internet of Things is the new normal state in the world of innovation, and an up-and-comer in the environmental world. IVL indeed has long experience of handling large amounts of measurement data – long before the concept of IoT became mainstream – but the demand for readily available environmental data in real time is growing and the digitisation of environmental research has probably come to stay.

"Bad weather is often good environmental weather."

"The point of Environmental Weather is for regular people to be able to see what the air quality looks like right now, along their way to work and school, and thereby get incentive to leave the car at home or maybe take a less congested bike path," continues Fredrik Hallgren. "It's important for us to make information out of data and use it to increase the knowledge among the public of environmental pollutants."

At miljöväder.se you can follow the pollution levels in the air right on your phone.

FREDRIK HALLGREN
Project Manager, Environmental Weather

SEVERAL PROJECTS IN THE INTERNET OF THINGS AND DIGITISATION

DigiDrick Water treatment works in Sweden and abroad are facing major challenges as the cities grow and the climate changes. Digidrick evaluates needs and potential for early warning systems, process monitoring, control, simulation and IT security in the Swedish and international market using digital solutions.

Detect New technology and ongoing digitisation make it possible to integrate large amounts of data and use multivariate analysis methods to detect process and sensor deviations. Detect will evaluate and validate the fault detection methods on process data to automatically identify sensor and process errors.

Sustainable attractive station communities
A Vinnova project with a dozen partners who seek to make it easier for private individuals in the towns of Ale and Lerum to live without a car using, among other things, an app for green mobility services.

Pictured: Fredrik Hallgren and Karin Persson check reference instruments for particle measurement. Photo: Jonas Tobin

Because although Gothenburg is one of the most monitored cities in Sweden in terms of air pollution, the environmental administration's six existing measurement stations provide an incomplete picture of the air in the city. Air pollution is local and the levels can change with a breeze and vary widely between two nearby locations. In the future, we want to have better monitoring with the goal of being able to apply customised, locally adapted measures, explains Hung Nguyen, Project Manager at the environmental administration in Gothenburg.

"It is a heavily trafficked city. We have more than 12 million passages passed the congestion toll stations every month. Stockholm has around 8 million. Moreover, the city is growing strongly with new homes and infrastructure. Air pollution will continue to be an important issue and Environmental Weather is a project of clear interest for making the problem visible."

"Air pollution is local and the levels can change with a breeze"

The Environmental Weather sensors should withstand weather and wind 24 hours a day for at least half a year. Calibration is still under way against the environmental administration's measurements, but towards the spring Fredrik Hallgren and the participants in the project will install a dozen boxes at ground level in highly trafficked areas like Korsvägen and Gårda.

In a similar project, Air and Water IoT, IVL together with the environmental administration and five other partners will measure pollution levels in air and stormwater in connection with the construction of the largest infrastructure project in Western Sweden in modern times, Västlänken, the western link. The objective is to be able to quickly react to environment-impacting deviations during construction. Air and Water IoT is also one of eight selected IoT hubs that has continued to seek long-term financing through Vinnova.

Andreas Englund is a business developer at IVL and is working with an internal project to investigate the digitisation potential in more areas than air and water.

"First, you have to ask yourself what digitisation means for IVL. Should the emphasis of our efforts be on data management and visualisation of real-time data, or online machines and systems and the consequences of digitisation for society? Right now, we mainly see a major potential on the mobility side by enabling services like Uber and Airbnb that make it easier for regular people to live climate smart.

Environmental product declarations are also a hot topic in the digitisation area, says Andreas Englund. Consumers increasingly inquire about the environmental impact of the goods they buy. In this area, IVL has come pretty far with eBVD and EPD – electronic building materials declarations and environmental product declarations that present a product's complete life-cycle analysis online.

"But without belittling the problems here at home, the issue of clean air and clean water is significantly more important in developing countries and rapidly growing economies. The possibilities of new, cost-effective technology are very interesting for countries like China and India, and it will in all likelihood just become more important."

30 YEARS OF COOPERATION WITH CHINA

2016 was a special year – IVL celebrated 50 years, but also that it was 30 years since IVL began its cooperation with China. IVL's local manager in Beijing, Gao Si, has seen IVL's operations in China develop and grow over the years. The office in Beijing now has 11 employees. Environmental awareness is growing in China and efforts to reduce the country's environmental problems are increasing.

"IVL has made major progress in China in these 30 years. We were pioneers then. There was hardly any money and little know-how. It was IVL who was the teacher and China was the student. But in the meantime, China has developed and then the projects change. It becomes more of a partnership where we learn from each other. Among other things, we recently had a project in the Guizhou province that was about improving people's environmental rights," says Gao Si.

What can Sweden and China learn from each other?

"Loads. China is a large country that invests long term and has proven to be able to take care of a large population during times of crisis. For its part, Sweden is a strong Nordic country with innovative capacity that is on the cutting edge of green technology. Areas like air, water and waste, here is where we can find extensive collaboration. Besides the technology, there is also the Swedish environmental thinking and we can learn a great deal from this in China. It is therefore that we have begun to emphasise more of this through training and knowledge transfer."

What is the most important thing IVL is doing in China right now?

"We have a number of joint venture projects for improving water and air quality. One of the more interesting things we have done recently is establishing a laboratory for the monitoring and analysis of air quality. This is a collaboration between IVL and the Chinese Research Academy of Environmental Sciences (CRAES) and others. The initiative has active support of China's government. So it's big.

"Another milestone during the year was our programme for food waste. Food waste is a growing problem in China; it is leading to huge waste among water, land and energy. In November, we arranged a conference in Beijing – an initiative to promote knowledge exchange about how we can reduce food waste. The conference attracted a large audience and received a lot of coverage in the media. This shows the huge interest exists concerning this issue in China, both among the authorities and among the general public."

Pictured are Gao Si and Juanjuan Yao at IVL's office in Beijing.

SWEDISH BIOGAS SOLUTIONS IN TIANJIN

There is a lot of interest in biogas solutions in China. In the city of Tianjin with its millions of residents, a Swedish consortium consisting of IVL Swedish Environmental Research Institute, Scania, Xylem Water Solutions and the environmental technology firm Malmbergs has developed a concept for how the city can introduce sustainable transport solutions. With the right technology, the city's treatment plants, besides reusable wastewater, can also generate a surplus of energy, including biogas and fertilisers. The waste sludge and organic waste can be converted into biogas at the same time that the waste is processed. The biogas produced can then be used to run the city buses. The solution for improving the city's air is of interest to Tianjin, which has now started a demonstration project for 50 buses to be run on locally produced biogas.

TRAINING PROGRAMME FOR CHINESE AIR ENVIRONMENT RESEARCHERS

At the beginning of the year, a delegation from the metropolis of Tianjin visited IVL Swedish Environmental Research Institute to participate in a training programme in air conservation work.

The delegation consisted of representatives from the city's environmental authorities and from Tianjin Academy of Environmental Sciences (TAES), which IVL has previously established cooperation with. The programme included a visit to the Swedish EPA and IVL's research facility Hammarby Sjöstadsverk.

"Every aspect of this visit is useful to us. Emission inventories, technical solutions, analysis work, remediation work and economic incentives – everything is related. We need complete solutions to turn the trend," said Zhao Enhai, Vice Director at Tianjin City Environmental Protection Bureau, which was one of the participants.

Photos, all: Anette Andersson

RESEARCH ON PHOTOCHEMICAL SMOG IN CHINA

The research project *Photosmog* focuses on how to counteract the smog in China. The air in two areas is being studied: Beijing and Hong Kong. The regions belong to different climate zones, have different kinds of photochemical smog and the authorities have different programmes of measures to fight the air pollution at the respective locations.

"China appears to have a mix of both so-called London smog that arises in part through coal burning, and photochemical smog with ozone formation and secondary particle formation that arises under the effect of strong sunlight. We want to try to map these substances and understand the dynamic between them," says Åsa Hallquist at IVL. She conducts research in atmospheric chemistry and during the year spent long periods in Beijing and Hong Kong to measure air pollution.

BETTER WATER IN TIANJIN BINHAI

Together with the Chinese partner TAES, IVL is leading the project Better Water in TBNA (Tianjin Binhai New Area). The project is a part of the programme EU China Environmental Sustainability Programme (ESP), which aims for a sustainable water management in the coastal cities in the run-off zone of the Hai River. Tianjin Binhai is a newly developed state growth area. Because of the areas rapid industrialisation and urbanisation, the local water authorities are facing complex challenges with climate changes, water shortages, pollution and degraded ecological values. The project seeks to propose policy changes, technical measures to reduce the pollution burden on the water system and ecological restoration to recreate ecosystem services for natural water purification.

CLIMATE EFFICIENT WITH HIGH-RISE OF WOOD

A study done by IVL and KTH in which two apartment building construction projects were compared shows that the emissions of climate gases were half as large for wooden buildings as for concrete buildings.

"The climate impact for building the wooden building is the lowest we have seen for an apartment building," says Martin Erlandsson at IVL Swedish Environmental Research Institute. The eight-storey building located in Sundbyberg is built of wood, but has a garage and cellar made of concrete. If one wants to make additional climate improvements, the largest potential is through actively choosing the kind of concrete used in the building, according to Martin Erlandsson.

Martin Erlandsson outside the wooden high-rise. Photo: Anette Andersson

LARGE DECREASE OF HEAVY METALS IN MOSS

Moss not only takes up nutrients from the air, but also heavy metals. On behalf of the Swedish EPA, IVL is studying metal levels in moss samples from around the country to see how they vary. The most recent inventory shows a significant reduction of lead, vanadium and nickel between 2010 and 2015.

"The levels vary from place to place in the country, but the decrease is generally large, around 30 per cent," says Helena Danielsson, Project Manager at IVL.

FIRST AIRPLANE WITH AN ENVIRONMENTAL PRODUCT DECLARATION

For the first time, an airplane has received an environmental product declaration. It is Bombardier Aerospace that environmentally declared one of its planes in the EPD system.

"We are very pleased to see the first EPD registration from the aviation industry. This shows that environmental product declarations are also useful for manufacturers of complex products as long as they have a desire to openly communicate the environmental performance," says Elin Eriksson, Unit Manager at IVL Swedish Environmental Research Institute's subsidiary EPD International.

EPD stands for Environmental Product Declaration and is an information system that objectively describes the environmental impact of goods and services from a life-cycle perspective.

According to Bombardier, 80 per cent of an airplane's environmental performance can be determined in the project engineering phase. This was something that affected their decisions from the beginning.

"With this environmental product declaration for our CS100 airplane, we can give our customers credible and comparable information on the environmental performance of our aircraft," says Fred Cromer, CEO of Bombardier Commercial Aircraft.

CAN WE ACHIEVE SUSTAINABILITY WITHOUT ECONOMIC GROWTH?

MIKAEL MALMAEUS
Researcher at IVL Swedish Environmental Research Institute

For a few years, IVL has participated in the interdisciplinary project Beyond GDP Growth, financed by the Formas research council. The objective of the project is to study what happens if the current GDP growth does not continue. What does such a society look like? What would it mean for our quality of life and for our welfare system?

These questions are interesting from several perspectives, not least in light of the future being uncertain. Taking continued economic growth for granted entails a risk.

Of course, the classic conflict between growth and the environment lies in the background. A growing production and consumption undeniably entails greater pressure on the earth's resources and has historically entailed larger amounts of waste and carbon dioxide emissions. Many people believe that it is difficult or directly impossible to live within the confines of the planet and at the same time have a growth economy. Others present good arguments for it being possible to break the tie between economic growth and negative environmental impact, such as by changing the content of the growth. For the time being, we have to confirm that the conflict remains unresolved, however.

Many people associate economic growth with technical progress and social development in general. And our improved living conditions in the past century have indeed been extensively related to an ever higher material standard tied to GDP growth. But oddly enough, the very rapid technical revolutions of recent decades in the form of computerisation, digitisation and IT communication have resulted in substantially lower growth compared with earlier decades. Or as Robert Solow, one of the 20th century's leading economists, put it: "You can see the computer age everywhere but in the productivity statistics".

This reduces the hope that a qualitative technical development can replace a quantitative increase in the amount of goods produced as the engine of growth. One way of understanding this is the fact that GDP is primarily a measurement of economic activity, not economic prosperity.

"GDO is primarily a measurement of economic activity, not economic prosperity"

The measurement was developed in connection with the Great Depression in the 1930s to be able to monitor how an economy is functioning, if the resources are being used or if the wheels are standing still. As long as we use this measure of growth, we will have to be satisfied with the amount of goods and services produced being in focus.

The good news is of course that society can develop in many ways without constantly increasing production and consumption. In the project Beyond GDP Growth, we investigate future scenarios where the circular economy, sharing economy, automation and self-supporting households are central strategies to achieve social and ecological sustainability. We are trying to find out what is required for such an economy to be able to handle employment, incomes and a fair distribution of resources. The end purpose is not reducing growth, but we choose to evaluate other and more important objectives, and ultimately GDP will become what it becomes.

14 LIFE BELOW WATER

IVL GETS TO THE BOTTOM WITH THE ASCIDIANS

Ciona intestinalis. Can the lowly vase tunicate be the answer to questions like how we can fix over-fertilisation, effective biofuel production, return nutrients to our fields, sustainable protein production for animal feed and circular fish cultivation? Put simply, yes.

We take a taxi boat out to the farm outside Djupvik on Tjörn in Bohuslän to take a look at these marine environmental heroes. Hundreds of buoys bob above the surface, holding up a full 70 kilometre long cultivation band, which at a few metres in depth is weighed down by ascidians.

Anna-Sara Krång and Fredrik Norén are marine biologists and old classmates. They are both based at the Lovén Centre Kristineberg research station in Fiskebäckskil, where IVL has a small, but growing office – even if Fredrik Norén himself is now more synonymous with Marin Biogas, the company that uses the actual ascidian farm.

"It tastes like oysters. Full of protein. Anyone want a taste?"

"Look here, prime ascidian, healthy and fine and ready for harvest."

He pulls a few clusters from the cold water. Decimetre-long, finger-thick and slippery. For nine months, they have been growing. In a few weeks, the harvest boat will come out and pull up a few tonnes that are immediately run through a press that squeezes out the water before being taken ashore for continued processing.

Fredrik Norén pushes the small organism out of its shell. It looks a little like soft orange candy. Can it be eaten? Absolutely, marine biologists are not afraid of the fruits of the sea.

"It tastes like oysters. Full of protein. Anyone want a taste?"

Anna-Sara Krång and Fredrik Norén at the ascidian farm outside Djupvik on Tjörn in Bohuslän. Photo: Jonas Tobin

These invertebrates grow naturally at a few metres depth along the entire west coast and have mainly been seen as a problem for mussel cultivation as they attach to the mussel bands. Besides marine biologists and environmental researchers, it has hardly any natural predators. Ascidians do their thing, filter the water of plant plankton and grow.

"It's a huge amount of biomass with a relatively small input. They require neither feeding, watering or care," explains Anna-Sara Krång, who can't say she enjoys ascidian as a snack.

The ascidian's soft shell or tunic as its called can be used as a raw material in various kinds of cellulose products, and the more protein-rich insides can be dried for ecologically sustainable and high-value fish or chickenfeed. The one hectare large farm in Djupvik can supply up to 160 tonnes of protein. Or the harvest can of course be converted into biogas corresponding to 65,000 litres of petrol if four times the cultivation bands are laid in the same area. The remains from the process can be converted to fertiliser that thereby returns nutrient salts to our fields.

As part of the deal, ascidians clean the ocean from over-fertilisation compounds – 26 tonnes of nitrogen and 2 tonnes of phosphorous are taken up in a year. With the environmental benefit, the possibility is now being investigated of selling nitrogen certificates, which would provide the operations a lift until profitability picks up.

One of the many on-going projects is also about the development of integrated cultivation systems.

"There is so much added value with the ascidian farm. The possibilities of so-called integrated aquaculture look really promising. By combining fish farming with ascidians and macro algae, one can achieve an almost environmental impact-neutral operation since they form a kind of ecocycle between them," says Anna-Sara Krång.

Fredrik Norén has developed the concept of large-scale cultivation of ascidians for biogas production.

The interest in for example sustainable salmon farming along the Swedish coast is huge, but in contrast to the Norwegian fjords, the Swedish coastal areas are more sensitive to the effects of over-fertilisation, which traditional fish farming often brings with it. But in an integrated aquaculture, the environmental impact is reduced and it would be possible to bring about fish farming in Swedish waters. An integrated and environmentally sustainable aquaculture also provides economic benefits since at the same cost for equipment and personnel, two or three more products can be made.

The cooperation with other actors in the industry, such as feed producers and fish farmers, and of course municipalities and other researchers is therefore absolutely central. IVL is a very important party, mainly by building up knowledge in life-cycle analyses and supporting the work with industrial applications, according to Fredrik Norén.

"The method we are investigating here incites huge interest and provides both economic and ecological sustainability. Moreover, it could create more jobs in small coastal towns. For the marine industries, this could be a game changer."

FACTS - ASCIDIAN CULTIVATION

The vase tunicate – **Ciona intestinalis** – an ascidian, is an invertebrate that belongs to the tunicates. They grow naturally in salt water and have an extensive capacity to build biomass quickly.

According to Marin Biogas, one hectare of ascidian cultivation, equivalent to the one in Djupvik of a total of 4,000 tonnes, can provide 650 MWh per year at the same time that it cleans the sea from 26 tonnes of nitrogen and 2 tonnes of phosphorous.

The remnants that come from the biogas facility can be used as ecological fertilisation for agriculture.

An increased production up to 1-2 TWh per year would entail a doubling of the Swedish biogas production, according to the Swedish Energy Agency.

In addition to pilot cultivation projects in Bohuslän, Marin Biogas has also placed cultivation bands in Skälderviken in Skåne to investigate the cultivation possibilities in more brackish water.

INDUSTRIAL WATER TREATMENT AT HAMMARBY SJÖSTADSVERK

Hammarby Sjöstadsverk water treatment facility is broadening its operations with a testbed for industrial water treatment. The testbed will be open to other interested parties and companies, making it unique in its kind.

"There is great demand for facilities where companies and industries can develop and improve their products and processes. With a facility like this, we can strengthen Swedish innovative capacity and exports in industrial water treatment, as well as attract foreign companies to place development operations in Sweden," says Staffan Filipsson at IVL Swedish Environmental Research Institute.

At the Hammarby Sjöstadsverk facility, municipal water treatment techniques are being developed today by researchers from institutes and universities and around 25 Swedish and foreign water treatment companies. The facility offers extensive infrastructure for the development, verification and demonstration of innovative solutions for water treatment.

LARGE AMOUNTS OF PCB IN OXUNDASJÖN

There are around 2 tonnes of the banned environmental toxin PCB in the lake, Oxundasjön. These are the findings of a study IVL conducted on behalf of Upplands Väsby Municipality in January.

"As far as we know, this is the largest collective amount of PCB encountered in the environment at one single location in Sweden," says Magnus Karlsson, researcher at IVL Swedish Environmental Research Institute.

In 2013, IVL conducted a regional study to trace environmental toxins throughout the Stockholm area. The study showed elevated levels of PCB in fish and sediments from Oxundasjön. Upplands Väsby Municipality has since continued the measurements and studies. The toxin lies 30 centimetres down in the sediment, which indicates that the supply of PCB to the area has been under way since the 1960s. Still today, there is no clear source that can explain the high level of PCB in Oxundasjön, so the search continues.

OILY BILGE WATER CAN BE CLEANED TO DRINKING WATER QUALITY

Every year, a few dozen tonnes of oil end up in the Baltic Sea through the release of dirty bilge water from shipping. The bilge water also contains many other pollutants that are toxic to the ocean environment. The IVL-led Bonus Project Zero Emissions in the Baltic Sea has developed technology that cleans bilge water to near-zero levels.

"We have shown that it's possible to make extensive progress with simple supplemental technology," says Hulda Winnes, Project Manager at IVL.

Together with the industrial concern Wärtsil' and the Lithuanian Klaipeda University, IVL Swedish Environmental Research Institute has developed existing treatment technology to the degree that bilge water containing oil can achieve drinking water quality.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

OUR SOCIETY IS LEAKING PLASTIC – WE HAVE TO CHANGE THIS

Light, mouldable, strong and inexpensive. Plastic has many characteristics and we use it for almost everything. At least 300 million tonnes of plastic are produced in the world every year. In total, 8 per cent of the world's oil is used for plastic production. By recycling more plastic, oil use can decrease, as well as carbon dioxide emissions and the need for waste treatment. But to get there, collection must increase and the recycled plastic has to become more competitive.

"Plastic has many advantages, but there are also many challenges linked to its extensive use. One problem is that we are globally consuming more and more. Our society is leaking plastic out to the environment. We have to get better at circulating and re-using the plastic several times and making sure that we can really take care of the plastic put on the market," says Anna Fråne, Waste Expert at IVL's Malmö office.

The largest area of use for plastic is packaging. More than 40 per cent is recycled in Sweden today, but by 2020 that percentage is to reach 50 per cent. Anna Fråne believes that achieving this goal will be a challenge. Most of the plastic packaging is still thrown out with the regular left over rubbish.

"More collection through source sorting demands the consumers' involvement. This is why it's important to understand what obstacles households see and what they demand to sort more at the source."

More source sorting and collection are needed, but there must also be a market for the recycled materials.

"Recycling is not one single activity, but rather a series of activities. To optimise the systems, cooperation and communication in the whole chain is necessary, from producers, collection, sorting and processing actors to those who use recycled plastics in their production."

"Recycling is not one single activity, but rather a series of activities"

To reach 50 per cent recycling, we need to stimulate the market for recycled materials and create demand, according to Anna Fråne.

"It has to become more cost-effective to use recycled plastic. New plastic is too cheap by comparison today. If there are then any doubts about the quality of the recycled plastic – then it's easy for a producer to choose new plastic instead."

Healthcare is one example of an area that large amounts of plastic are used and disposed of every day. Little material is recycled; most is incinerated out of caution. In a project in the strategic innovation programme Resource, IVL together with other actors is studying if the recycling of hospital plastic can be safely increased. IVL's role is to evaluate the environmental impact of various solutions and pre-processing methods.

"What's technically recyclable is one thing and what works in practice is another. A solution might require a lot of chemicals or be energy intensive; that's

FOUR FACTS ABOUT PLASTIC

- In 2016, more than 320 million tonnes of plastic was produced in the world.
- The largest amount of plastic is produced in China.
- In Europe, plastic is used primarily for packaging (around 40 per cent) followed by the construction sector (around 20 per cent).
- In Sweden, more than 200,000 tonnes of plastic packaging was put on the market in 2015 (excluding PET bottles).

Pictured is Anna Fråne, Waste Expert at IVL Swedish Environmental Research Institute's Malmö office. Photo: Jonas Tobin

what we're looking at. The ever current question is "at what price". For new solutions to be good, they have to be of use for the entire chain otherwise there will be suboptimised processes," says Anna Fråne.

The broad area of use of plastic means that it as waste ends up in innumerable, more or less pure waste streams. IVL is therefore working with several different plastic waste flows, from packaging to waste from the construction and demolition sector, the healthcare sector, scrapped cars and electronics.

A question that incited much attention in recent years is the littering and the large amount of plastic that ends up in our oceans. Regular plastic rubbish from consumers is believed to be one of the major sources of the plastic that ends up in the sea.

"The cities are sources of plastic in the ocean. The plastic is broken down to smaller and smaller particles, which then enter our food chain," says Anna Fråne.

IVL is participating in the EU project Blastic, where four countries around the Baltic Sea will map the route of plastic from the city to the sea, what the large sources are and what the routes of spread are. The project, which has been named a flagship project, is being funded by the Central Baltic Programme and is led by the Keep Sweden Tidy Foundation. A new approach is that regional and national strategies are being put to practical use in the project at a local level. In Sweden, Södertälje is a pilot area.

The objective is to develop a guide for how the municipalities can work to reduce littering by plastic macro waste in the sea. The guide will include everything from how to map the sources of the littering to how to measure the plastic waste and prepare action plans.

"The idea is that it should be easier for municipalities to apply the right measures in the right place so that they can stop the supply of plastic waste at the source," says Anna Fråne.

ARTIFICIAL GRASS FIELDS SPREAD MICROPLASTIC IN THE ENVIRONMENT

When IVL Swedish Environmental Research Institute investigated possible sources of microplastic in the ocean in 2016, artificial grass fields came in second place. This concerns around 2,000 tonnes of rubber granulate that is spread every year from Sweden's more than 1,300 artificial grass sports fields.

"It was unexpected that it involved such large amounts. We don't know how much ends up in the ocean environment, and the routes of spread for the rubber granulate that disappears from the fields is unclear. More research is needed to be able to say how much reaches the water environment and what potential measures should be applied," says Mikael Olshammar at IVL.

The largest losses are assessed to take place in snow clearance of the plans and the amount of loss therefore varies across the country. Most of the fields today are designed so that it is difficult to measure and clean microplastic that goes with rain and melt water.

The mapping that IVL conducted on behalf of the Swedish EPA is the largest to-date of sources and routes of spread for microplastic done in Sweden.

Microplastic is small plastic particles, less than 5 millimetres in size, that can bind environmental toxins and be taken up by water animals that believe it to be food.

The largest source of emissions to the environment proved to be road and tyre wear from traffic, estimated at around 8,000 tonnes per year. Other sources are synthetic fibres from laundry, wear from boat hulls, industrial plastic production and emissions from hygiene articles that contain microplastics.

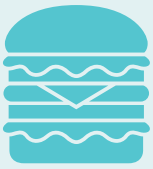
The particles are carried to the ocean through wastewater treatment plants, stormwater, snow dumping and through air transport.

CLIMATE BENEFIT OF SECOND HAND

On behalf of Schibsted Media Group, IVL worked out what potential environmental benefit is provided by the second hand trade of the media group's market places. The calculations show that, by trading in second hand items instead of buying new products, 12.5 million tonnes of greenhouse gas emissions can be saved during one year.

Trading on Blocket contributes to a potential savings of 0.8 million tonnes of carbon dioxide – the same amount that Stockholm's road traffic emits in one year.

The results are based on statistics from Blocket in Sweden and its equivalents in Norway, France, Italy and Spain. Together, these ad sites have 46 million unique visitors every month. The calculations build on the assumption that the products bought and sold on the marketplaces replace the production and transport of new products, and that they products sold do not become waste.

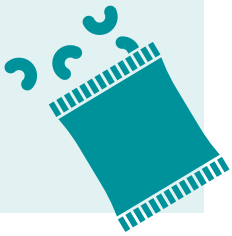


NEW INFORMATION ON FOOD WASTE IN EUROPE

On average, we throw out 173 kilograms of food per person and year in Europe. This is shown by new figures from the EU project Fusions, which IVL participates in. In total in the EU, this involves 88 million tonnes of food waste that ends up with the rubbish. Households account for the largest contribution.

However, there are still large gaps around food waste data. To improve the reporting, a manual was also prepared in the project that should help authorities concerned in the EU countries to introduce standardised measurements of the amounts of food waste.

"With EU-wide approaches to measure the amounts of food waste, it will become easier to prioritise and apply preventive measures to reduce the food waste," says Åsa Stenmarck, waste expert at IVL.



ECOSMART TO RECYCLE WASTEWATER

Recycling wastewater is both ecosmart and cost effective. These are the findings of a research project that IVL conducted together with the technology firm Xylem. With the right technology, wastewater can be so clean that it can be returned to the groundwater or re-used in agriculture and industry.

In the project, eight different treatment systems were combined, including ozone treatment. The systems were then tested and optimised at Hammarby Sjöstadsverk in Stockholm in cooperation with a number of full-scale facilities around the world.

"By recycling wastewater, we can meet many of the challenges that are in society in terms of the water supply. With lower groundwater levels, higher costs to treat fresh water and a water shortage due to environmental destruction, this issue has never felt more important than now," says Christian Baresel at IVL.

IMPACT OF SWEDISH WASTE IMPORT ON RECYCLING

Last year, more than 1.3 million tonnes of waste was imported to Sweden to become district heating and electricity.

One study that IVL conducted shows that there is a lot in the waste that could be materials recycled. The reasons this is not currently done are mainly financial.

The import of waste leads to reduced landfill deposits and reduces waste incineration in the countries that export their waste to Sweden, i.e. Norway, the UK and Ireland. In terms of the effects on the materials recycling in these countries, the study indicates that they are small in practice. The market for secondary raw materials and the countries' national recycling goals play a major role here.

However, more knowledge is needed about how the waste import affects the Swedes' desire to source sort their waste.

NEW METHOD TO REMOVE PHARMACEUTICALS ALREADY IN THE TOILET

Many medications are difficult to break down. They pass through today's water treatment plants and end up in the water environment, sometimes at harmful levels.

At Uppsala University Hospital, a new technology is being tested to clean out pharmaceutical remnants directly in the toilet bowl. The technique is based on enzymes that are tailored to break down various pharmaceuticals.

The same kind of enzymes that are formed among bacteria that have become resistant to antibiotics. Behind the method is the company Pharem Biotech, which is testing and optimising the technology at IVL's research facility Hammarby Sjöstadsverk.

"If we can use enzymes directly at large point sources, like hospitals and elderly care centres, we can also make the break-down of pharmaceutical remnants more effective," says IVL's Christian Baresel, Project Manager at Hammarby Sjöstadsverk.

REINFORCEMENT IN BIOGAS

In 2016, IVL acquired the consulting firm BioMil to strengthen its operations in biogas. The company works with the entire value chain in the biogas field – from substrate issues with pre-processing through digestion technology and emission issues to the use of the products of biogas and bio fertiliser.

"This acquisition strengthens our possibilities to increase the implementation of biogas solutions both in Sweden and abroad. We are now reaching a critical mass in terms of personnel and are gaining a good mix of theoretical and practical know-how," says Östen Ekengren, Executive Vice President at IVL Swedish Environmental Research Institute.

Photo: Daniel Tamm

MUNICIPALITIES THAT ARE BEST AT CLIMATE ADAPTATION IN SWEDEN

In June, IVL and the Swedish Insurance Federation presented their annual ranking of Sweden's municipalities' work on climate adaptation.

This time, first place went to Vänersborg, followed closely by Lomma and Uppsala with a shared second place.

The mapping also shows that one out of five municipalities still have not begun their climate adaptation work.

"The climate adaptation among Sweden's municipalities is going far too slow. Even if some municipalities are more vulnerable than others, the entire country will be affected by climate changes. Preparedness must increase for heat waves, landslides and strong downpours, to name a few," says Philip Thörn at IVL Swedish Environmental Research Institute.

Large municipalities have generally made more progress than small and medium sized municipalities, and coastal municipalities have established their climate adaptation work to a greater extent than inland municipalities.

INDUSTRY AND TRANSPORS
THE LARGEST CHALLENGE FOR A CARBON DIOXIDE-NEUTRAL NORDIC REGION

In May, Nordic Energy Technology Perspective 2016 was launched – a Nordic version of the well-known global publication by the International Energy Agency (IEA). The report shows that the Nordic countries can achieve a carbon-dioxide neutral region by 2050 by cooperating – but that it demands that politicians take the challenges of industry seriously and increase the pace in the transport field.

Particularly difficult are the process emissions from steel and cement production. To get rid of them, either major technical breakthroughs are needed or the emissions must be separated and stored in the ground.

The transport sector, which accounts for more than 20 per cent of the Nordic region's greenhouse gas emissions, can be made fossil free with a combination of electrification, bio fuels, smarter urban planning and mobility solutions. But the tempo of the changeover needs to be properly increased.

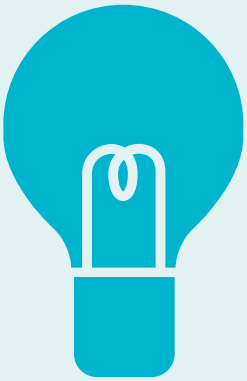
"There are loads of political tools we know work here and can be used more. Infrastructure initiatives must be more closely tied to the climate goals, vehicle taxes should be further differentiated and the terms for company car benefits must be revised, to name a few examples," commented Markus Wråke who was responsible for the Swedish part of the report.

RE-USE
OF OFFICE FURNISHINGS

Every year, thousands of tonnes of fully functioning building materials from offices are disposed of.

"There is a large turnover of tenants in office properties and many want to put their own mark on the offices when they move in. It's quite common to tear own existing furnishings and buy completely new ones," says Carina Loh Lindholm, Project Manager at IVL Swedish Environmental Research Institute.

IVL's study shows that, with collaboration between tenants, property owners, building firms, architects and resellers, more office furnishings can make it the whole way from building to building.



SAFER
AREAS WHEN RESIDENTS ARE INVOLVED

Involving the residents in the renewal of residential areas can create security and involvement. This is shown by the Suburban Lab project. In the Stockholm suburb of Alby, the residents had the opportunity to participate in the development and implementation of several renewal measures in the residential area. One such measure was to improve the lighting along a walkway at Albyberget.

"The sense of security along the walkway improved at the same time that energy consumption was cut in half using new LED technology," says Anja Karlsson, Project Manager at IVL Swedish Environmental Research Institute.

CITIES ARE GROWING, PARKING SPACES ARE SHRINKING

Last year, around 370,000 new cars were sold. The weak trend with emission reductions as a result of fuel-efficient engines and more biofuels is now being counteracted by a resurgence in road traffic. It is time to put an end to this.

Photo: Jonas Tobin

In ten years, Johanneberg Science Park on the campus of the Chalmers University of Technology will grow by four thousand jobs. There will be more homes and offices, but no new parking spaces. With the so-called Green Transport Plan, accessibility to the area will instead increase with more bus lines, bike paths and car pools.

"Urban densification at the expense of parking spaces is a relatively simple way to reduce car travel. It happens a bit below the radar. At the same time, a dialogue must be conducted with tenants and residents in the area so that their needs for mobility can be met," explains IVL's Sara Sköld, who is leading the Vinnova project that will study the effects of the effort at Johanneberg.

At the adjacent Gibraltarvallen, hundreds of cars are lined up this Monday morning. Here, it costs SEK 500 a month to park. That is half as expensive as the surrounding and more ground adapted parking areas. An important measure is to increase the fee, or otherwise tax the difference as a benefit, according to IVL's mobility expert Anders Roth.

"Higher fees are never popular. Cars are a part of our society, with strong rules, norms and traditions. They affect our industry and are still important to our perception of status and freedom. The congestion tax that was introduced a few years ago met with strong opposition."

But more incentives are needed that hold steady to the principle that the polluter should pay, which will make it more expensive to use a car in urban environments. Subsidies that directly increase driving have to be revised. One example is the car benefit system, which comprises more than 250,000 cars and makes it inexpensive to drive far in large cars, and where the congestion charges and benefit value of free parking are also included, according to Anders Roth and Sara Sköld.

"The price tag for installing a parking space is between SEK 100,000 and more than SEK 500,000."

Parking in particular also costs the tax payers and housing construction large sums of money. The price tag for installing a parking space is between SEK 100,000 and more than SEK 500,000. Parking spaces not only take up valuable area in the city, but also make housing construction more expensive.

"According to today's formulation of the Planning and Building Act, parking should be arranged to a reasonable extent. We want more dimensions of accessibility to be taken into account, not just the car perspective," continues Anders Roth, who sold his own car 14 years ago.

In parallel with Sweden's ongoing construction boom with an emphasis on in-fill urban development, aspects of sustainable urban development and

“Cars are a part of our society, with strong rules, norms and traditions.”

Pictured are Anders Roth and Sara Sköld, IVL Swedish Environmental Research Institute

"In the future city, it is the function of being about to move about that is important and not that it is done with one's own car."

green mobility are also increasingly being heard in the debate. And there are several indications that the municipalities want to go ahead of the state with progressive initiatives. Most talked about right now is perhaps environmental zones that close out vehicles with high emissions from certain central parts of the city, and diesel bans that growing numbers of large cities are planning, which Oslo actually introduced temporarily in the middle of January.

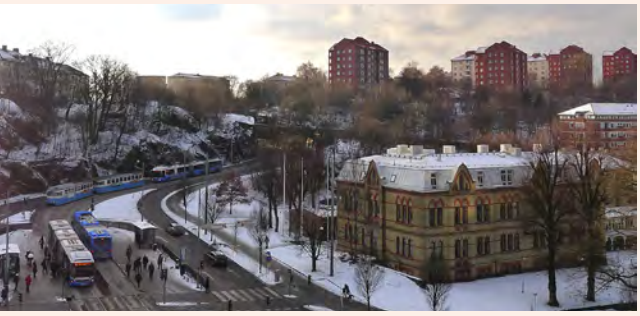
During the year, IVL added new expertise and established a steady operation around green mobility in particular. Transport issues that concern emission calculations, freight transports and shipping have been tied together with sustainable urban development and a dozen projects are directly linked to transport-efficient urban planning.

"In the future city, it is the function of being about to move about that is important and not that it is done with one's own car. The role of the car in the city is changing as the area becomes more valuable and many different functions are to fit in the same space," says Anna Jarnehammar, Unit Manager of Business Development and Market. "I find it hard to see the cities not working more in this direction. The alternative is simply more expensive and worse."

URBAN MEASUREMENT NETWORK CELEBRATES 30 YEARS

In 1986, the same winter that the first cars with catalytic converter entered use, IVL began cooperation with Sweden's municipalities to monitor air quality in Swedish urban areas. Since then, IVL has done daily measurements of nitrogen dioxide, sulphur dioxide and soot. At the beginning of the 1990s, measurements began of volatile hydrocarbons and then in 2000, the municipalities were offered the possibility to measure particulates with IVL's particulates sampler. The measurements resulted in a unique database with more than half a million daily averages from the 120 municipalities that participated over the years.

Until a few years ago, the curves in the Urban Measurement Network indicated a steady improvement in the urban areas, but now, the trend has turned or in any case levelled out.



LARGE CLIMATE BENEFIT FROM EATING LESS MEAT

Reduced meat consumption has a large potential climate benefit – much larger than switching from beef and pork to chicken. This is shown by a model that researchers at IVL developed to calculate the effects of various incentives on European food consumption.

The study also shows how large a challenge the food area is. To achieve the 2-degree target, we have to reduce emissions from today's 9 tonnes of carbon dioxide per person and year to 2 tonnes. Food consumption along currently gives rise to 2-3 tonnes of carbon dioxide emissions per person and year.

BALANCING ACT WHEN CLIMATE CHANGE IMPACTS ENVIRONMENTAL GOALS

Climate change is making the environmental efforts a balancing act. Several environmental goals are at risk of being pitted against one another – in other cases, one measure can benefit multiple environmental goals at the same time. This is the conclusion reached by the CLEO project that after six years of deliberation delivers its synthesis report to the Swedish Environmental Protection Agency.

"We studied a complex tapestry of environmental effects and action impacts. Our research shows a probable direction, but it is no forecast," says John Munthe, Programme Director in CLEO and the Vice President of Research at IVL.

Researchers at CLEO have worked out different scenarios for future climate, air pollution and forest management change, and based on these, assessed the potential impact on the environment.

The evaluations rely on extensive data and model calculations and focus on the environmental goals of Fresh air, Only natural acidification, No over-fertilisation and a Toxin-free environment.

CLEO's research shows how much of the climate changes in the Arctic are due to reduces sulphur emissions in Europe. At the same time, it is confirmed that continued sulphur reductions will continue to have a small climate effect.

CLEAR IMPROVEMENT OF THE ENVIRONMENT OUTSIDE FOREST INDUSTRIES

Researchers from IVL Swedish Environmental Research Institute, SKUTAB, Nordmiljö and the University of Gothenburg have evaluated how environmental conditions outside Swedish paper and pulp mills have developed in the past 50 years.

The study shows that areas that were considered to be depleted and poisoned in the 1960s and 1970s have come back to life and that plant and animal life has recovered in pace with reductions of emissions.

At the same time, there are water areas where the recovery is going slower and where the effects of environmental toxins remain. One likely explanation may be that pollutants from earlier emissions were stored in the bottom sediments. The report shows that some areas are also more sensitive to receiving emissions than others.

REDUCED WATER AND ENERGY CONSUMPTION IN THE PROCESS INDUSTRY

With 11 partners and SEK 70 million in funding, the IVL-led EU project Inspirewater aims to reduce water and energy consumption in the process industry. New solutions are to be tested on one of Sandvik's production plants.

The goal is to reduce water consumption in the steel and chemicals industries by 40-80 per cent and energy use by at least 20 per cent. This is to be done using a combination of existing separation processes and new technologies.

"The water supply is becoming more and more sensitive in many different regions – even in countries that have a lot of water overall. A competitive European industry therefore needs effective water management and it is there that Inspirewater will contribute," says Uwe Fortkamp, Project Manager at IVL Swedish Environmental Research Institute.

Inspirewater is funded through the EU framework programme for research and innovation Horizon 2020.

DIFFICULT TO ACHIEVE THE PHOSPHOROUS EMISSIONS GOAL

The natural phosphorous load, meaning what occurs without human influence through natural degradation processes in the environment, is larger than Sweden's emissions target. This is shown by a mapping of Sweden's emissions of over-fertilisation substances to the Baltic Sea and the North Sea.

The study was done by IVL together with SLU and others on behalf of the Swedish Agency for Marine and Water. The materials comprise around 23,000 water areas throughout Sweden.

"Extensive work was behind the results. We reviewed all Swedish land, and calculated what virtually every field, built area and forest area emits," says Heléne Ejhed, Project Manager at IVL.

The natural leakage of phosphorous accounts for 370 tonnes and the goal that Sweden has set in the Baltic Sea Action Plan is 308 tonnes. This shows how difficult the phosphorous goal is to achieve. The researchers also assess that the load from stormwater and small run-off is larger than what previous studies showed.

EVA AXELSSON /
Group Manager Chemical Products
IVL Swedish Environmental
Research Institute

IVL INVESTS IN CHEMICAL INFORMATION

During the year, IVL strongly expanded and employed some 20 people from the vehicle and transport sector with specialist expertise in information on the health and environmental risks of chemicals. Eva Axelsson leads one of the two newly formed groups located in Gothenburg.

Why is IVL doing this work?
"Chemicals play a major role in society and occur in many different contexts. Some substances have proven to have harmful effects on people, the environment and various kinds of organisms. Authorities are also gradually introducing new regulation mechanisms. For IVL, it is natural to be a part of this development, to both participate in research and assess risks of chemicals, and to help companies and organisations to practically adapt their operations to reduce the impact from their own use."

Why is information on the risks and impact of chemicals important to industry?
"First and foremost, knowledge is needed to be able to handle chemicals safely. All actors also have an obligation to be aware of and follow the legislation in the area that is relevant to their own operations. It is also an advantage to be proactive and avoid substances and products that can later be subject to potential limitations and where one might need to change production or the product. Having knowledge is a responsibility, but it's also smart."

What services does IVL generally offer in the chemicals area?
"IVL conducts analyses of chemical substances, assessments of chemicals' health and environmental risks, support to obtain knowledge of legal requirement and good chemicals handling, mapping of pollution, decontamination assignments and much more. The assignments range from characterisation of specific industry emissions to large-scale screening, both in Sweden and internationally. We also regularly report national data for the Swedish EPA."

COMPETENT AND COMMITTED EMPLOYEES ARE THE KEY TO SUCCESS

For a knowledge company like IVL, it is of the utmost importance to be an attractive employer that can retain talented employees and attract new ones.

With its broad range of operations in the sustainability field, IVL can offer interesting work in an international arena and the chance for employees to be involved and contribute to sustainable social development.

At IVL, there is a broad field of competencies, from engineers, chemists, biologists and geologists to social scientists, political scientists and economists. IVL also has strong specialist expertise; nearly one third of the employees hold Ph.D.s.

STRONG EXPANSION

IVL is in an expansion phase and the number of employees increased sharply in 2016. To achieve our vision of a sustainable society, we need knowledge and creativity. Consequently, we need a diversity of employees and as varied and broad a composition of employees as possible, considering gender, age and ethnic background, religion, disability and sexual orientation. Equality and diversity issues are significant in connection with recruitment of new employees and the issues are guided by policies and plans for recruitment, as well as equality and equal opportunity.

The gender distribution has been even for several years among both managers and other colleagues.

EXPERTISE AND LEADERSHIP

In order for IVL to deliver applied research and professional services that meet the needs of society and the customers and retain competitiveness, the employees' expertise and skill are absolutely crucial. IVL's view of skills development matches the so-called the "70-20-10 model", in which 70 per cent of skills development takes place in day-to-day operations, 20 per cent through learning from experienced colleagues and 10 per cent via more formal training activities.

The goal is for all employees to have at least two days of skills development through defined activities per year. In 2016, the average time was 3.1 days per employee, divided by an average of 3.5 days for women and 2.7 days for men.

COURSES THROUGH IVL'S PROJECT OFFICE

Virtually all activities at IVL are conducted in project form. In a step towards quality improvement and the further professionalisation of project managers, IVL developed an in-house management-training project in four stages.

In 2016, a total of 78 employees underwent project manager training and 12 employees attended special sales courses. In 2016, a new experiential exchange initiative was carried out in

Rui Wang at IVL's China office is an expert in sustainable biogas solutions. Photo: Anette Andersson

the form of breakfast meetings for 83 project managers tied to the management system's main process, the project process.

MANAGEMENT AND LEADERSHIP DEVELOPMENT

Since 2013, IVL has a programme for leadership development that comprises all managers. The programme builds on IVL's defined success factors for leaders and combines common training modules with individual coaching. In 2016, a new course began for some ten new group managers.

EMPLOYEE TALKS

Annual employer and development talks provide every employee a change to set goals and look at his or her contribution to IVL's total development together with his or her manager. The talks result in individual development plans.

EMPLOYEE SURVEY

Every two years, an employee survey is conducted with the help of an external organisation, where all employees have the opportunity to anonymously express their opinions on IVL as an employer and workplace and their own development opportunities.

The survey measures and provides index ratings for leadership, working climate and commitment. The ordinary survey was done in 2015 and it showed a general improvement from an already high level with regard to leadership, working climate and employee commitment. A smaller follow-up study was done in 2016 that showed continued good results although the leadership index had declined slightly.

The various departments build on the results of these surveys, using them as springboards for activities calculated to maintain or improve the work environment. At an organisation level, the results of the survey form the basis of discussions in the Work Environment Committee and for the work environment plan.

WORK ENVIRONMENT, HEALTH AND SAFETY

It is important for IVL to offer a work environment that promotes creativity and the commitment necessary to be able to provide high-quality research and consulting services.

The formal work environment efforts in IVL are governed by a work environment policy and driven through delegation and an annual work environment plan. The plan is drafted by a Work Environment Committee that coordinates the work while it is led by the group managers in daily operations.

In 2016, group managers underwent special work environment training focused on the social working environment, which is in line with new regulations from March 2016.

The work at IVL is largely conducted on computers inside the offices and to reduce negative effects of sedentary activities and occasionally monotonous work behind a screen, annual ergonomic inspections are conducted. The employees are offered equipment and treatment by a naprapath to reduce any strains.

A large number of employees work at laboratories and test facilities, in part with substances that may entail health risks. Therefore, considerable importance is placed on injury prevention measures.

Other challenges that must be addressed are field work and lone work.

Sickness absence increased slightly compared with the year before and accounted for 2.9 per cent (2.62) of the working hours.

IVL has agreements for occupational health services that cover all employees who are also offered regular health check-ups. All employees are offered free vaccinations during the flu season. To encourage a healthy lifestyle, all employees receive an annual fitness benefit. IVL subsidises a wide range of active employee sporting and cultural activities.

CHALLENGES AND PLANS FOR THE FUTURE

IVL attracts and recruits high-performing employees. Particular attention is therefore placed on measures for handling stress. The concrete work is done in part within the respective group and in part in the form of coaching groups.

At the end of 2015, a coaching project began where a number of senior employees received training in supporting less experienced coworkers in handling challenging situations and duties. Besides teaching less experienced coworkers to handle challenging duties, the project aimed to increase the exchange of knowledge and enhance the efficiency of the project work.

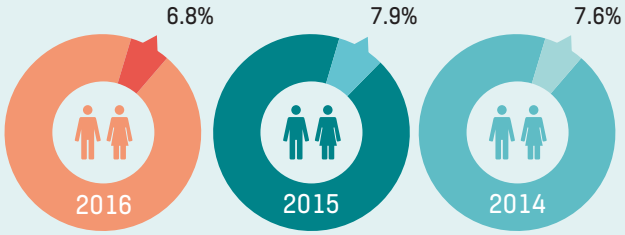
The coaching project has been successful and in 2016, a pilot study was conducted with the aim of formalising coaching within the company.

THE CHINA OFFICE IS A SPECIAL CHALLENGE

The employees at IVL's office in China are covered by the same policies and benefits as the employees in Sweden. However, the external environment, particularly the air, mainly in Beijing is occasionally a health hazard. IVL has therefore equipped both the offices and the employees' homes with air filtering equipment.

Pictured are Therese Zetterberg, Tina Skårman and Tomas Ekvall, three of the six coaches in IVL's coaching project.

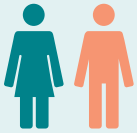
EMPLOYEE TURNOVER

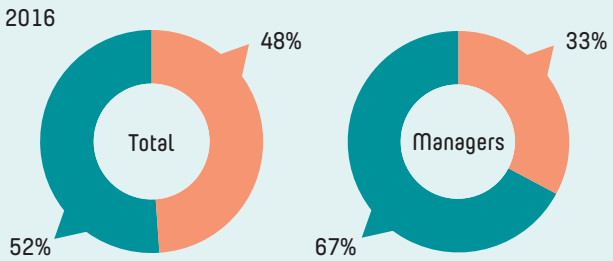


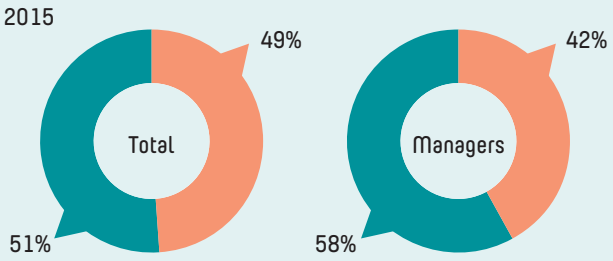
TURNOVER / EMPLOYEE

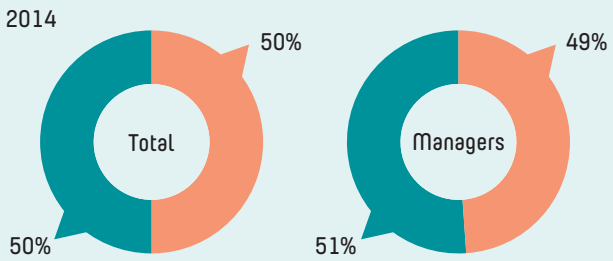
2016	2015	2014
1 067	1 098	1 010

GENDER BALANCE









ETHICS AND RESPONSIBLE BUSINESS

For IVL Swedish Environmental Research Institute, independence and credibility are fundamental to the entire operation. Independence is guaranteed by the ownership structure, a foundation jointly formed by the Swedish government and Swedish enterprise. IVL was founded with the mission of providing independent and credible decision input that all parties could rely on and support. We continue to work according to this tradition.

CODE OF CONDUCT

IVL Swedish Environmental Research Institute has a Code of Conduct that is based on the company's core values and the UN Global Compact's ten principles in human rights, labour rights, the environment and anti-corruption.

Our core values are credibility, foresight and a holistic approach. As employees, we are committed and do work that benefits society and our customers.

The Code of Conduct has been adopted by the IVL Board and governs the company's relationships with employees, suppliers, business partners and other stakeholders. The code applies to employees as well as to members of the Board.

IVL encourages all suppliers and partners to follow the Code of Conduct. In evaluations of current and future suppliers, the principles in the Code of Conduct shall be applied.

In connection with the code being adopted, workshops were held for all employees to clarify the contents of the code.

Information on IVL's Code of Conduct is provided in connection with the introduction of all new employees.

WHISTLE-BLOWER FUNCTION

Linked to the code is a whistle-blower function on the intranet. There, all employees can anonymously, without personal repercussions, file a report on suspected violations of laws, ordinances and/or the Code of Conduct.

RISK ASSESSMENT OF PROJECTS

In connection with tenders and application, a risk assessment is done, partly linked to our Code of Conduct and core values. The aim is to identify in advance possible risks with the project in question and identify possible measures and/or to decide whether IVL should refrain from entering the project.

RESPONSIBLE INVESTMENTS

A certain amount of the company's liquid assets shall always be available in a checking account, but in addition to this minimum liquidity, there is a freedom to invest funds in alternative manners and for a longer term. The Board annually decides how large this sum is.

Investment guidelines are set forth in a policy document and are based on sustainability criteria. For example, issuers of securities shall contribute to sustainable development, and report both the positive and negative environmental and social impact of their products and services on ecosystems and society at large.

PLANNED ACTIVITIES

Since a large number of new employees began at IVL in the past two years, internal activities are planned for 2017 to highlight the Code of Conduct and discuss its application. A special effort is planned for IVL's employees in China where the application and understanding of the code is extra important.

Pictured is Mila Harding in the lab at Hammarby Sjöstadsverk, IVL Swedish Environmental Research Institute.

DRIVING SUSTAINABILITY EFFORTS FORWARD THROUGH GRI REPORTING

MIKAEL EKHAGEN
Sustainability Expert and Group Manager for LCA and Environmental Management at IVL Swedish Environmental Research Institute

GRI, Global Reporting Initiative, is one of the world's most used and well-known frameworks for sustainability reports. GRI's guidelines for sustainability reporting have been around since the end of the 1990s and have gradually been developed to strengthen companies and other organisations to understand and communicate significant sustainability aspects.

Mikael Ekhagen is a Sustainability Expert and Group Manager for LCA and Environmental Management at IVL. He has done several sustainability reports, including that of the power company, Vattenfall.

Why should GRI reporting be done?

"Sustainability reporting in accordance with GRI is a good way to drive the sustainability efforts forward in the operations through reporting. As GRI is based on both a value chain and stakeholder perspective, the reporting principles help organisations prioritise the most important sustainability aspects, both inside and outside the core operations of the organisation. The report effectively interacts with strategic development of the sustainability work and has helped many take the sustainability work from a pure communication issue to a strategic business value."

Which companies should report according to GRI?

"All organisations that want to work with the sustainability issue in a structured and transparent way should in some way work based on GRI's guidelines. This does not mean that all companies need to prepare the actual reporting, but the approach recommended should be used in all organisations. A report according to GRI can be an effective way of meeting stakeholder expectations of transparency in the sustainability work. Consequently, the report is especially important for the organisations that have stakeholders with an extensive interest in sustainability issues."

What can IVL help out with in terms of GRI reporting?

"IVL can support companies through the entire process from mapping of the operations and stakeholder dialogues, through the materiality analysis, goals and strategies to the finished sustainability report.

GRI INDEX – CONTENT AND PAGE REFERENCES

IVL Swedish Environmental Research Institute reports information on the company's sustainability work together with the operation's development and financial performance in the annual report. The sustainability report, like the annual report, pertains to the 2016 financial year and comprises the Parent Company unless otherwise stated. The sustainability-related information in the annual report is not audited by a third party.

IVL intends to report annually and for the 2016 financial year, issues its first report in accordance with GRI, Global Reporting Initiatives, guidelines for G4 Core level. Through stakeholder dialogues and materiality analyses, IVL has identified the aspects that are of material significance to the company.

In other words:

- Benefit of IVL's products and services - Customer satisfaction/Environmental benefit
- Work environment, health and safety
- Gender equality, equal opportunity and diversity
- Competence and management development
- Ethics and integrity

IVL reports at least one indicator per aspect. The most significant aspects are based on our most important resource - our employees, and the advice and recommendations we give to customers in our results and products. This GRI index refers to where in the annual and sustainability report the information is presented.

GRI INDICATORS WITH PAGE REFERENCE AND COMMENTS

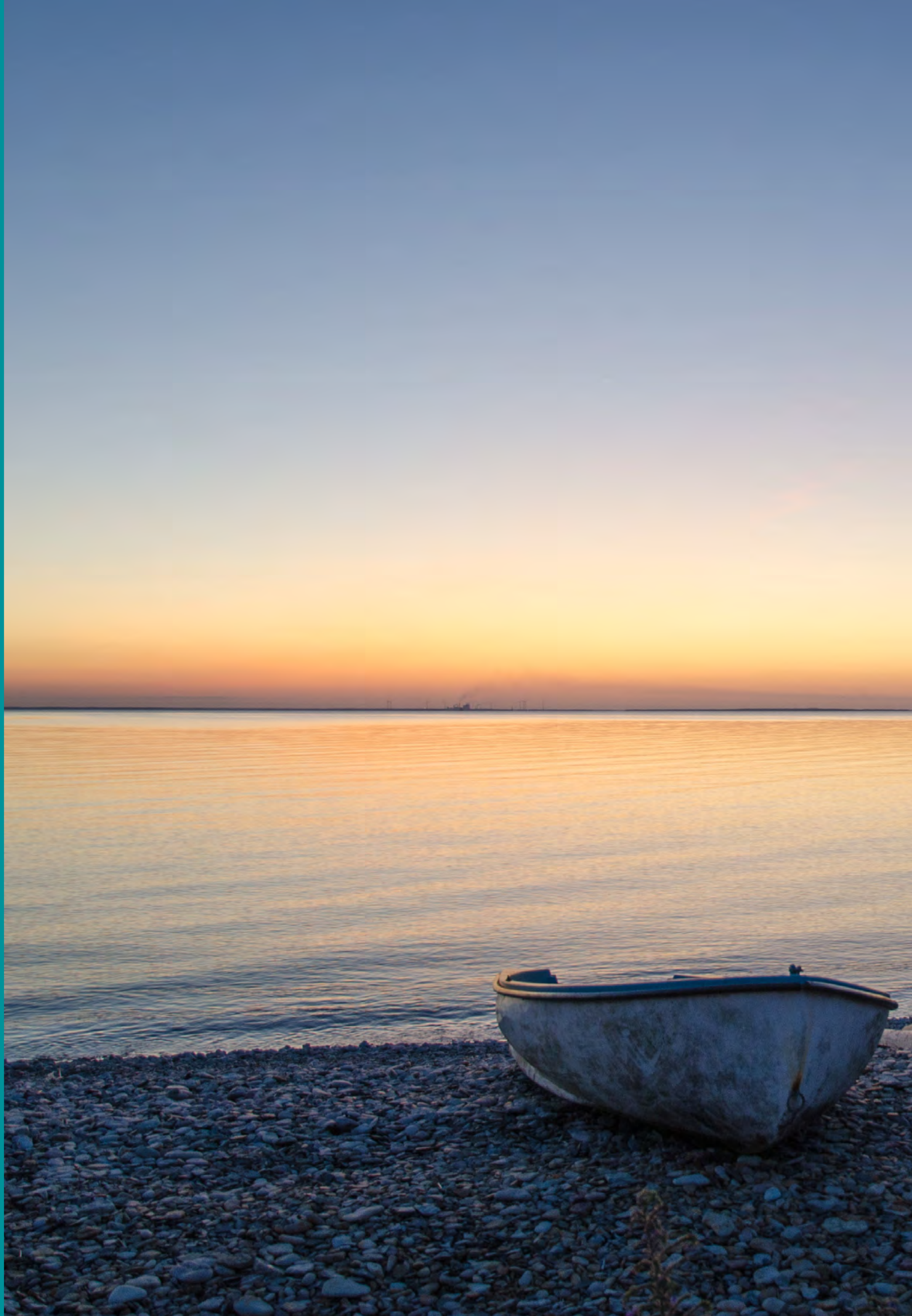
INDICATOR	PAGE	COMMENTS AND EXCLUSIONS
GENERAL DISCLOSURES		
STRATEGY & ANALYSIS		
G4-1 Statement from the CEO	1	
G4-3 Name of the organisation	1, 52	
G4-4 Primary brands, products and services	13	
G4-5 Location of the organisation's head office	54	
G4-6 Countries where the organisation operates	52	
G4-7 Ownership structure and legal form	54	
G4-8 Markets served	57	
G4- 9 Scale of the organisation	60, 70	
G4- 10 Number of employees, gender, region, etc.	Inside cover, 44, 60-61, 72	
G4-11 Percentage of employees covered by collective bargaining agreements		IVL's employees in Sweden are covered by collective bargaining agreements.
G4-12 Supply chain	17	
G4-13 Significant changes during the reporting period regarding size, etc.	56	
G4-14 Precautionary approach	57	Expected future development and significant risks and uncertainties are presented by our work to identify and work with risks associated with markets, competitors, employees and financial risks.
G4-15 External principles or other initiatives the company follows	46-47	IVL follows the international reporting principles of GRI IVL's Code of Conduct is based on the UN Global Compact's principles.
G4-16 Participation and membership in associations and networks	52-53	

GRI INDICATORS WITH PAGE REFERENCE AND COMMENTS

INDICATOR	PAGE	COMMENTS AND EXCLUSIONS
IDENTIFIED MATERIAL ASPECTS AND BOUNDARIES		
G4-17 Parts of the organisation included in the report	52	Unless otherwise noted, the report refers to the company IVL Swedish Environmental Research Institute
G4-18 Definition of the report content and relevant sustainability aspects	14-15	
G4-19 Material aspects	14-15	
G4-20 Material aspects within the organisation	14-15	
G4-21 Material aspects outside the organisation	14-15	
G4-22 Effects of restatements of information provided in previous reports		A sustainability report according to GRI is issued for the first time in 2016
STAKEHOLDER ENGAGEMENTS		
G4-24 Stakeholder groups	14	
G4-25 Identification and selection of stakeholder groups	14	
G4-26 Approaches to stakeholder engagement	14	
G4-27 Key topics and concerns that have been raised through dialogues with stakeholders	14	
REPORT PROFILE		
G4-28 Reporting period	51	
G4-29 Date of most recent previous report		A sustainability report according to GRI is being issued for the first time in 2016
G4-31 Contact information for the report	1	
G4-30 Reporting cycle	48	
G4-32 Reporting principle, GRI index	48	
G4-33 External review		The sustainability report is not reviewed externally
GOVERNANCE		
G4-34 Governance and ownership structure for the organisation	54	
ETHICS AND INTEGRITY		
G4-56 Company's core values, principles, standards and norms for conduct	13, 46	

SPECIFIC DISCLOSURES

SATISFIED CUSTOMER		
G4-DMA	16	
G4-PR5 Results of surveys measuring customer satisfaction	16	Employer and development talks
WORK ENVIRONMENT, HEALTH AND SAFETY		
G4-DMA	44,60	
G4-LA6 Extent of injuries, absences and accidents	44,60	IVL reports on this indicator only on sickness absence
DIVERSITY AND EQUAL OPPORTUNITY		
G4-DMA	42,60	
G4-LA12 Composition of Board and management by gender and age	44,60, 78-79	
COMPETENCE AND MANAGEMENT DEVELOPMENT		
G4-DMA	42,60	
G4-LA9 Training	42,60	
ETHICS AND INTEGRITY		
G4-DMA	46	
G4-SO4 Communication and training on anti-corruption	46	



DIRECTORS' REPORT

The Board of Directors and CEO of IVL Swedish Environmental Research Institute hereby submit their annual report for the operating year 1 January 2016 – 31 December 2016, the company's thirty-fifth financial year.

CONSOLIDATED OPERATIONS

IVL Swedish Environmental Research Institute (IVL), with corporate identity number 556116-2446, conducts applied research and consultancy assignments across the entire environment and sustainability area. Our customers are to be found in all industries, government agencies and organisations. Operations are based in Sweden and Europe, but our customers are located throughout the world, particularly in China, where IVL has been active for more than 30 years. IVL has offices in Stockholm, Gothenburg, Malmö, Beijing and Fiskebäckskil.

IVL was founded in 1966 and is owned by the Foundation of the Institute for Water and Air Research (SIVL). The Swedish government and the Swedish business sector appoint directors to serve on IVL and SIVL boards. IVL has operated as a limited company since 1982.

Besides the Parent Company IVL, the Group also consists of the subsidiaries Bastaonline AB, EPD International AB, IVL Environmental Technologies (Beijing) Company Ltd and the joint venture Sino–Swedish Environmental Technology Development Center, SEC, in China. IVL's operations are essentially conducted within the Parent Company.

PARENT COMPANY

The purpose of IVL's operations is to promote ecological, economic and socially sustainable growth in business and society through applied research and consultancy projects. Activities are structured into four operational units, together with research, business development and marketing units that operate laterally across the organisation. IVL's working methodology is characterised by an interdisciplinary and holistic approach. The company is active across the entire area of sustainability, and for this reason, in addition to its traditional expertise in the environmental field, IVL employs behavioural and social scientists, financial and communications experts.

Our activities range across the entire industrial spectrum, and our customers represent Swedish society in its entirety; from small and medium enterprises to large multinationals, industrial and trade organisations, public agencies – of which the Swedish EPA is the largest single client – as well as local authorities and other organisations.

Hammarby Sjöstadsverk

Hammarby Sjöstadsverk is one of Sweden's leading R&D facilities in water purification technology. The facility, which is operated by IVL and KTH, is used in both national and international research projects and as a test and pilot facility for the private sector and other parties. The facility forms the basis of the Sweden Water Innovation Center – SWIC.

The activities have grown strongly since they commenced in 2007 and today, municipal water purification technologies are developed at the facility by researchers from institutes and universities as well as around 25 Swedish and international water purification companies. At present, some 30 IVL employees are working on 20 different R&D projects at Hammarby Sjöstadsverk.

In 2016, a Vinnova-financed project was begun to broaden the activities to become a test bed for industrial water purification as well.

Hammarby Sjöstadsverk is member of a collaborative partnership with KTH, Uppsala University, the Swedish University of Agricultural Sciences (SLU) and Mälardalen University, a centre for municipal wastewater treatment with funding from the Swedish Water & Wastewater Association (SWWA), and municipal authorities in the Mälardalen region.

Fiskebäckskil

The company conducts the majority of its marine activities at the Lovén Centre Kristineberg research station in Fiskebäckskil, which is a part of the Sven Lovén Centre for Marine Infrastructure at the University of Gothenburg. Today, IVL has extensive research in marine micro debris and maritime environmental effects of emissions from bilge and scrubber water and the development and evaluation of new forms of aquaculture.

Among the larger projects that IVL conducts at this location are Baseman (Defining the baselines and standards for microplastics analyses in European waters) and Plastox (Direct and indirect ecotoxicological impacts of microplastics on marine organism) with financing from JPI Ocean. IVL's experts in Fiskebäckskil work on an assignment basis with micro debris analyses in different water and as expert support for HaV and other authorities. In the Vinnova project, Integrated Aquaculture, a new circular concept for joint cultivation of ascidians, macro algae and fish together with the innovation company Marin Biogas.

International operations

IVL is engaged in extensive international operations. Europe is regarded as the company's domestic market, while elsewhere the main focus is on China and India.

Communication, training and seminars

Communication, along with seminar and conference organisation, falls within the scope of the Business Development & Market unit. Consequently, communication is an integral part of the company's business development.

Communication has become increasingly important, as a component of research programmes and generally as a means of increasing awareness of IVL's activities. In this regard, courses and seminars are essential, particularly as a means of consolidating IVL's role as an arena where stakeholders from the research community, industry, public and political spheres can meet. This was especially the case with the conferences on "The State of the Environment", "Towards Non-toxic Building Practices", and the annual Baltic Sea Seminar and "Sustainable Transports".

COLLABORATION WITH UNIVERSITIES

IVL's role is to act as bridge builder between the research and business communities, and to create arenas of interaction between different social actors. This is one of the reasons why IVL plays an active role in networks and cooperative ventures of various kinds, some of which are featured above. IVL is also involved in a long line of European technology platforms, such as, WSST (water), ESTEP (steel), FBST (forest) and ECTP (construction).

Other examples:

SPIRE – a network working to increase resource efficiency in the process industry.

ENERO – European Network of Environmental Research Organisations – is a group of European research institutes operating under the umbrella of the European Research Area (ERA). IVL is an active member.

EURAQUA – the European Network of Freshwater Research Organisations. IVL is the Swedish representative.

Norman – a network of reference laboratories and research organisations involved in the screening of new, environmentally hazardous chemicals.

LIGHTHOUSE – Nordic centre for maritime expertise and a collaboration between Chalmers, the Gothenburg School of Business, Economics and Law and the Swedish Shipowners' Association.

NTM – the Swedish Network for Transport and environment. As member of the network, IVL has worked in formal collaboration with NTM since 2009. The aim is to strengthen cooperation by placing IVL's expertise at the disposal of NTM members and working groups.

SMED – the Swedish Environmental Emissions Database, a consortium formed in 2001 by IVL, Statistics Sweden (SCB), the Swedish Meteorological and Hydrological Institute (SMHI) and the Swedish University of Agricultural Sciences (SLU) to gather and develop Swedish competence in emission statistics relating to action programmes in the fields of air and water pollution, waste, and hazardous substances and chemicals. Since 2006 SMED has supplied all data required for Sweden's international reporting in these areas, and the present framework agreement expires 2022.

STOCKHOLM CLEANTECH – a spinoff of the Stockholm Environmental Technology Centre, initiated and administrated by IVL. Stockholm Cleantech connects visitors, stakeholders, projects, technologies, companies and researchers active in the field of environmental technology in the Stockholm/Mälardalen region.

GROUP COMPANIES

BASTAONLINE AB

Since 2007, Bastaonline AB (CIN 556719-5697) has been owned by IVL (60 per cent) and the Swedish Construction Federation (40 per cent). Bastaonline AB has its registered offices in Stockholm and its operations are located at IVL's head office. The company manages and develops the BASTA system for evaluating and phasing out particularly hazardous substances in building materials. Initially totalling 58, the number of suppliers joining the system had increased to 403 by the end of 2016, when more than 40 new suppliers joined during the year. At the end of 2016, 30,000 products (22,500) were registered, which corresponds to more than 110,000 individual articles.

Since the beginning, the BASTA system has been developed with the BETA register and the Basta Project Management Tool, which at the end of 2016 had around 550 registered projects and 2400 users. Since the knowledge of materials that do not meet the Basta requirements is limited, Basta has taken the initiative to a third group, "Risk evaluated" products, that provides information on products that are difficult to replace and where there are recycling systems or a clear substitution plan.

Net turnover for the financial year was SEK 6,329 thousand (5,604) and profit after financial items was SEK 711 thousand (204).

For more information, see www.bastaonline.se

EPD INTERNATIONAL AB

Since 1 July 2014, EPD International AB (CIN 556975-8286) is a wholly owned subsidiary of IVL. The company has its registered offices in Stockholm and operations are located at IVL's offices in Stockholm, Gothenburg and Beijing. The company operates and manages the EPD system, which is a programme for third-party verified Environmental Product Declarations, EPDs. An EPD is an optional tool for companies to communicate the environmental impact of their products (goods and services) in a life-cycle perspective with a comparable and credible method.

The company's tasks include providing information about the system, maintaining the regulations, organising international collaboration and registering and publishing approved environmental and climate declarations. In total over 650 EPDs from more than 150 companies in 33 countries have been published at www.environdec.com, and in 2016 184 new EPDs from companies in 19 different countries were registered, an increase of 32 per cent compared to the year before.

During the year, the fourth EPD International Stakeholder Conference was held in Milan, Italy, and a breakfast seminar in Malmö together with the BASTA system. A cooperation agreement was signed with the Norwegian EPD Foundation during the year.

Net turnover for the financial year was SEK 3,310 thousand (2,894)and profit after financial items was SEK 251 thousand (loss: 7).

SINO-SWEDISH ENVIRONMENTAL TECHNOLOGY DEVELOPMENT CENTER LTD (SEC)

For more than ten years, IVL and the Tianjin Academy of Environmental Sciences (TAES) have been joint owners of Sino-Swedish Environmental Technology Development Centre Ltd. (SEC), based in Tianjin. SEC has helped a large number of Swedish environmental technology companies enter the Chinese market.

IVL ENVIRONMENTAL TECHNOLOGIES (BEIJING) COMPANY LTD

Since 2014, IVL has a wholly owned subsidiary in China. The company is primarily dedicated to the provision of environmental consulting services and technology transfer for the Chinese market. In 2016, the company began cooperation with ten Swedish companies. Net turnover for the financial year was SEK 707 thousand (834) and the net profit was SEK 222 thousand (248). The company has three employees.

FINANCIAL PERFORMANCE

GROUP

Consolidated net turnover for the financial year increased by 7 per cent (4) to SEK 294,741 thousand (274,232), with a profit after financial items of SEK 256 thousand (5,392). There was a loss after tax of SEK 100 thousand (profit: 4,017). Return on equity was 0.2 per cent (5.1), and return on assets was 0.2 per cent (2.9). Average return on equity over the last five years was 8.1 per cent (11.5).

The Group's total assets increased to SEK 205,621 thousand (196,794), and equity decreased to SEK 83,722 thousand (83,900). Cash flow was a negative SEK 13,576 thousand (positive: 15,005).

Investments for the year in tangible and intangible fixed assets amounted to SEK 10,551 thousand (11,285). The equity/assets ratio decreased to 34.6 per cent (36.1).

For a more detailed financial overview and key figures, please refer to Note 2.

PARENT COMPANY

IVL's net turnover for the financial year increased by 7 per cent (4) to SEK 292,570 thousand (272,812), with a profit after financial items of SEK 46 thousand (7,173). There was a loss after tax of SEK 359 thousand (profit: 3,067).

The main reasons for the lower profit in 2016 are large costs, both external and internal, associated with the 50th anniversary, the development of our offices in Stockholm, Gothenburg and Malmö and costs for operating acquisitions.

Total assets amounted to SEK 197,914 thousand (190,880), and equity amounted to SEK 56,647 thousand (57,006). Adjusted equity is estimated at SEK 68,575 thousand (68,935). Cash flow was a negative SEK 14,770 thousand (positive: 16,008).

Adjusted return on equity was 0.1 per cent (8.4), and return on assets was 0.1 per cent (4.1). Average return on equity over the last five years was 11.1 per cent (13.6).

Investments for the year in tangible and intangible fixed assets amounted to SEK 9,710 thousand (10,669). The equity/assets ratio decreased to 34.6 per cent (36.1).

For a more detailed financial overview and key figures, please refer to Note 2.

ORGANISATION AND CORPORATE GOVERNANCE

OWNERSHIP

Since 2004, IVL has been wholly owned by the Foundation Institute for Water and Air Research (SIVL), CIN 802006-2611, with its registered offices in Stockholm. The foundation's purpose is to develop the long-term conditions for environmental research at IVL and, through ownership, to guarantee IVL an independent status.

SIVL is governed by a representative Board of Directors, of whom the Chair and six members are appointed by the Swedish government and seven members by the Swedish business community. SIVL is the sole owner of IVL and proposes members to the board of IVL, partly by inviting nominations from industry representatives, and partly by inviting nominations from government.

BOARD WORK

During the 2016 financial year, IVL's Board of Directors held four ordinary meetings, in addition to the statutory meeting and a strategy meeting, which was held in September. Board work primarily comprises strategic issues, financial statements, major investments and acquisitions. The Board receives regular reports on the performance of the company's operations and finances. Selections of the company's operations are also presented at ordinary meetings. The CEO acts in a presenting capacity at the Board meetings.

The Board appoints a remuneration committee from its members, tasked with the submission of remuneration guidelines, and other terms of employment for the CEO and other members of executive management. The committee shall consist of at least two members, appointed for a term of two years.

GROUP MANAGEMENT

IVL's executive management consists of the CEO, the Executive Vice President, the CFO, the Vice President Business Development and Marketing and the Director of Research. The company's management group also includes the four unit managers, the Director of Human Resources and the Director of Communications. The Director of Quality and Environmental Issues is a co-opted member of the management group.

ORGANISATION

IVL's operations are organised into four operational units, which are in turn divided into a number of groups with group managers tasked with managing personnel and capacity planning. Other units focus on business development and marketing, as well as research, which operate laterally across the entire organisation. All units interact in a matrix organisation covering four thematic areas: "Natural resources, climate & environment", "Resource-efficient recycling & consumption", "Sustainable production & environmental technology" and "Sustainable urban development & transport".

Four operational councils with external stakeholders are tied to the respective focus areas. Participants in the operational councils are appointed by IVL's owner foundation SIVL.

IT

IVL works actively with information security issues to ensure that customers can rely on the data provided by the company and that all data is guaranteed adequate protection. IT systems are an indispensable and entirely critical resource in the handling of digital material, data, communication and information. IT systems are used in accordance with current policies and IVL's Code of conduct. IVL restricts access to data and software from unauthorised users via login routines. Backups are taken on a regular basis to ensure that data can be restored with as little loss as possible. Some critical systems are built so that business can continue to function in the event of damage to the system and in addition support the company's crisis management.

In 2013, IVL began strategic investment in a new laboratory data system. Since then, analytical techniques have been successively phased in, the project is on track and should be completed 2017 as projected.

SUSTAINABILITY REPORT

IVL reports information on the company's sustainability work together with the operation's development and financial performance. IVL reports in accordance with the GRI Global Reporting Initiative's GRI G4 CORE level guidelines. Through stakeholder dialogues and materiality analyses, IVL has identified the aspects that are of material significance to the company. In other words:

- Benefit of IVL's products and services - Customer satisfaction/Environmental benefit
- Work environment, health and safety
- Gender equality, equal opportunity and diversity
- Competence and management development
- Ethics and integrity

A report on the principles and GRI indicators is presented in its entirety in the printed annual report under the section GRI index – content and page references.

ENVIRONMENTAL AND QUALITY MANAGEMENT

IVL works on environmental and quality issues within the scope of an integrated management system. The system and its implementation at IVL is ISO-certified for environmental and quality management in accordance with SS-EN ISO 14001 and SS-EN ISO 9001. The certifications are maintained annually and renewed periodically by accredited certification agencies.

The major part of the operations comprising sampling, field measurements and analyses are accredited and audited regularly by SWEDAC in accordance with SS-EN ISO/IEC 17025:2005.

Quality

IVL's work on quality focuses on customer relations and for that reason activities are regularly followed up to ensure that customers are satisfied with the company's work. This is done in the form of telephone interviews with at least two customers per operational unit. The customers are representative of the business sector, municipalities and government agencies. In 2016, the Customer Satisfaction Index (CSI) ranking was 4.3 (4.2) on a scale of 1 to 5. In addition to several suggested improvements, the internal report on the interviews revealed a positive image of IVL as a professional and important partner and supplier. IVL's long-term focus on project manager training made a positive impression on customers.

SIGNIFICANT EVENTS DURING THE YEAR

Growth and strategic recruitment
In 2016, the company extensively reinforced the workforce and expanded operations. In the spring, the consulting firm Biomil was acquired with five employees who transferred to IVL. The acquisition of Biomil, which conducts project engineering for biogas system solutions, provides IVL with greater opportunity to increase biogas implementation projects both in Sweden and abroad. With its practical experience, Biomil complements IVL's theoretical know-how in the field.

In September, IVL assumed operations from a customer with a total of 24 people, including three consultants, in the areas of chemical products, risk assessments, safety data, chemical assessments and sustainable production, including work environment, eco design, environmental management and life cycle assessments. This transition means that IVL has gained a significant reinforcement with several employees who have extensive experience of working in industrial production with various processes, as well as a breadth in the product area.

The acquisition has entailed not insignificant costs in the form of both internal resources and external costs, such as legal fees.

In addition to this, the company made a number of strategic recruitments of individual senior people with key expertise in important development areas.

The regional expansion in southern Sweden continued in 2016. IVL's Malmö office was reinforced and had 11 employees at year-end.

As a result of the on-going expansion, the company began a process in 2016 to meet the need for suitable work spaces through a transition to activity-based workplaces. The premise has been the aim to continue to have operations located in the immediately vicinity of Chalmers, KTH and Malmö University. Evacuation and renovation of existing offices will take place in 2017-2018.

Strategic projects
Noteworthy among the large projects IVL brought in during 2016 is the EU-financed research project *Inspire*. With a total budget of around SEK 70 million over five years, of which IVL's part of the budget comprises SEK 17 million, it is one of the larger projects in the EU framework programmes for Horizon 2020. The project aims to reduce water and energy consumption in the process industry. Particular focus is on the steel and chemicals industry. Eleven partners from six different countries are participating in the project, which is being led by IVL. Sandvik is the Swedish industry partner.

The absolutely largest project IVL brought in during 2016 was the climate policy programme of the Mistra research foundation called *Mistra Nepsis*. With a budget of SEK 80 million over four years, it is one of Mistra's largest initiatives ever. Non-Emission Products and Services in Sweden (Nepsis) aims to prepare proposals on how Swedish industry can make the transition to be able to meet the target of zero net greenhouse gas emissions by 2045. IVL is leading the programme and has formed a consortium together with Chalmers and a large number of other universities and industrial companies.

At the end of 2016, IVL was commissioned by the Swedish government, through the Swedish Energy Agency, to establish an export platform to promote Swedish environmental and climate technology and smart cities in the scope of the Hammarby Sjöstad 2.0 concept. The project will run until 1 January 2019.

Visibility
IVL's strategic initiative on editorial visibility in the media and in the public debate continued to provide results. In 2016, IVL was sited in the media 1,334 times (1,484), measured in the number of press clippings. This is an advertising value of around SEK 36 million, as estimated by the TT-owned company Retriever based on what corresponding space would cost to buy as advertisements.

During the year, particular attention was devoted to both IVL's 50-year anniversary and the 30-year anniversary of IVL's work and presence in China, including the anniversary conferences in October.

Leadership and quality
The leadership training programme that was launched in 2013 continued in 2016, and included the training of new group managers. During the year, a special initiative was conducted with the aim of increasing the volume and quality of consultancy assignment sales.

ANTICIPATED FUTURE DEVELOPMENTS, MATERIAL RISKS AND UNCERTAINTIES

In 2016, IVL's management continuously assessed and monitored the risks associated with the company's operations. Risks were also addressed at the Board meetings during the year. At the same time, risk analyses tied to daily operations, including the work environment, were conducted at the respective unit.

Long-term expansion
IVL's long-term goals, adopted by the Board of Directors, include a specific target for expansion. The target set is a doubling of turnover by 2020 and represents annual growth of 10 per cent. This growth is to be achieved both organically and via acquisitions, although without compromising the quality of research and consultancy work. Expansion is necessary if IVL is to be able to continue contributing to sustainable development in the business sector and the rest of society, as well as in the international market.

The Market
Europe, and in particular the Nordic region, is IVL's largest market. Customers are served in a number of industries including the energy, public and industrial sectors, plus the construction and property sectors. As a result, the company is dependent on stable growth in these areas to achieve its targets and manage the risks arising from economic and structural change, as well as evolving market trends. At the same time, the IVL's vulnerability to short-term fluctuations is reduced by being active in multiple markets and in sectors and industries susceptible to different business cycles. Systematic and periodic assessments of IVL's situation relative to external factors create a high degree of readiness to cope with change.

Competitors
IVL contends with both major international competitors and small local ones in every market. This poses a risk, as there is fierce competition for the most attractive projects and the most highly-skilled employees. Against this background, continuous assessment of these risks is vital.

Employees
To attract and retain highly skilled employees, the company invests in continuous training, as well as skills and leadership development. IVL can also offer large, complex international projects, which is attractive to prospective employees.

To retain employees, IVL invests in skills development and leadership development. Employee development talks are held every year with every employee, where individual development plans are discussed and formulated.

Sustainability
IVL operates in a global market, which increases risks related to sustainability factors such as human rights, working conditions, the environment and corruption. These risks are reduced by a communicated and established environmental policy, and environmental work that is followed up under a certified environmental management system. There is also a code of conduct that sets the ethical rules for IVL's relationships to customers and the rest of the world. There is a whistle blowing channel that provides every employee the possibility to report any deviations from the code of conduct in a way that ensures privacy.

Financial risk
By the nature of its business, IVL is exposed to financial risks, consisting of fluctuations in income and cash flow resulting from changes in exchange and interest rates, and credit risk. However, on the whole, the financial risks to the company are relatively minor. Nevertheless, currency risks arising from fluctuations in anticipated and contracted payment flows in EU projects total EUR 3.9 million (4.8). A change of SEK 0.10 in the exchange rate for the SEK will impact income to the extent of SEK 0.5 million (0.7), taking project matching into account. The company continually assesses the need for hedging of payment flows, but during 2016 elected not to engage in hedging. During the year, exchange rate gains totalled SEK 1.3 million (0.2).

The company's credit risks comprise outstanding, not-yet invoiced consultancy projects. IVL's 30 largest customers, accounting for approximately 75 per cent of turnover, consist exclusively of major international corporations, the European Commission and major international corporations, the European Commission and Swedish and foreign government institutions.

Sensitivity analysis

IMPACT ON	CHANGE, % (ALL ELSE EQUAL)	IMPACT ON INCOME, kSEK		
		2016	2015	2014
Chargeability ratio	1	3,726	3,227	3,130
Hourly rate	1	2,370	2,141	2,076
Payroll costs	1	1,693	1,487	1,399
Overheads	1	623	566	540
Number of full-year employees	1	1,038	870	850

RESEARCH AND DEVELOPMENT

RESPECTIVE SHARES OF RESEARCH AND CONSULTANCY WORK

During the year, the shares of fees earned and expenditure incurred in IVL's research and consultancy activities accounted for 51 per cent (53) and 49 per cent (47), respectively. In this context, "research activities" refers to (i) research co-funded by central government and the business sector via SIVL, and (ii) activities that are grant-funded via central government research bodies, research foundations, the EU and the equivalent. Co-funded operations accounted for 16 per cent (19) of fees earned and expenditure incurred, while grant-funded operations represented 33 per cent (33)

IVL's research is an integral part of the company's operations and an essential factor in IVL's ability to conduct a consultancy business with top expertise.

IVL's consultancy activities comprise not only short-term consultancies and analysis projects, but also more substantial research and development projects nationally and internationally.

Consultancy

In addition to consultancy projects for industry, municipalities and other organisations, IVL also conducts major projects on behalf of the Swedish EPA, including responsibility for most of the national monitoring of air and precipitation and, together with parties in SMED, for the collection and reporting of Sweden's combined emissions regarding air, water, waste and hazardous substances.

EU projects

During the year, several projects with partial funding from various EU bodies were approved and started, among them Horizon 2020, Bonus and outstanding funds from the EU's Seventh Framework Programme for Research. In total, IVL participated in 33 EU-funded research projects in 2016, of which seven were new. Among them are *Inspire*, which aims to enhance the efficiency of water management in process industries, and *Miware*, which is about extracting resources from mine water.

Other current research programmes

In 2016, the Mistra research foundation granted SEK 80 million over four years to the IVL-led research programme *Mistra Nepsis*, which aims to prepare proposals on how Swedish industry can become climate neutral by 2045. IVL is also participating in the new Mistra programme *Mistra Terra Clean* that seeks to develop smart materials for the cleaning of air and water. IVL was already involved in *Mistra Future Fashion* and *Closing the Loop* and is one of the parties in the consortium behind *Mistra Urban Futures* with its registered office in Gothenburg.

Besides this, IVL is leading research programmes that are financed by the Swedish EPA, such as SCAC *(Swedish Clean Air and Climate Research Program)*.

IVL has received funding from Vinnova for projects involving automated sorting of textile waste with the aim of increasing textile recycling and a project intended to develop digital solutions for the monitoring and control of water treatment works.

The insurance firm, AFA Försäkring, finances research projects in IVL that concern work environment issues. In 2016, a total of SEK 9.8 million was approved for a project on strategies for a sustainable working life – attractive jobs and adaptation of the work to the employees working capacity.

CO-FUNDED RESEARCH

SIVL is the owner of the Company and acts as the principal in IVL's co-funded activities. In 2016, research was conducted in four thematic areas: *Natural resources, climate & environment, Resource-efficient recycling & consumption, Sustainable production & environmental technology and Sustainable urban development & transport.*

Watchwords for IVL's research are high quality and relevance.

During 2016, a total of SEK 37 million (37) was available to SIVL for co-funded research via government appropriations of SEK 17 million (17) to the EPA and SEK 20 million (20) to Formas. The total volume – SEK 86.2 million (80.4) – for co-funded research is made up of that amount, plus SEK 20.0 million (20.2) from industry and SEK 29.1 million (23.2) from the EU. In 2016, SEK 5 million was received through Formas for basic funding of the activities as a complement to the co-funded research.

For 2017, SIVL will have SEK 47 million at its disposal for co-funded research, of which SEK 10 million is funding that can be used for basic funding of the activities.

EXAMPLES OF CO-FUNDED RESEARCH

Examples of co-funded research projects approved and/or commenced in 2016 within the respective thematic areas:

- Natural resources, climate & environment: *Ranking of the climate-adaptation work of Sweden's municipalities*
- Resource-efficient recycling & consumption: *Water use in connection with the cellulose industry*
- Sustainable urban development & transport: *Environmental evaluation of energy solutions in buildings*
- Sustainable production & environmental technology: *Site-wide energy efficiency improvements in Domsjö*

FOREIGN AFFILIATES

IVL's operations in China continue to expand. At year-end 2016, the Beijing office had eight employees. The operations are primarily focused on research and consulting, education and knowledge transfer, relation-building with Chinese authorities, companies and organisations and technology transfer.

Collaboration with the Chinese research institute CRAES, one of the most prominent advisers to China's government, continues to be developed in the environmental field. IVL and CRAES work together on the measuring of emissions into the air, and have the joint laboratory, the Sino-Swedish Air Joint Lab. Additionally, IVL's employees at the Beijing office, together with IVL's air quality experts, developed and implemented an air protection training programme targeting representatives of the environmental authorities in the city of Tianjin and, an established IVL partner for many years, TAES, the Tianjin Academy of Environmental Sciences. Part of the training was held at IVL's Gothenburg office.

Since 2015, IVL has one employee from IVL's China office stationed in Wuhan in the Hubei province in central China. Work there includes assisting a representation office for Dalarna County and Borlänge Municipality (IVL Wuhan Center SweDalar Office), which has agreements with the city and the province, and helping with market research and the organisation of seminars and workshops.

ENVIRONMENTAL IMPACT

The company's most significant environmental effects have been identified as advice to customers, travel and energy use. Goals have been set for these effects and they are monitored annually. At project completion IVL carries out a sustainability assessment, which to date has generated a positive index, provided that IVL's advice is followed.

Environmental permits

The company's operations do not require permits under the Swedish Environmental Code Act. On the other hand, IVL is licensed to handle asbestos subject to regulations from the Swedish Work Environment Authority. Since neither of the two company laboratories in Stockholm and Gothenburg exceed 5,000 square metres of premises, there is no registration obligation as mandated under environmental impact assessment regulations.

PERSONNEL

STRUCTURE AND PERSONNEL TURNOVER

The number of employees during the financial year averaged 249 (228), of whom 48 per cent (49) were men and 52 per cent (51) women. The operating units are divided into teams with appointed team managers. Of the total of eight unit managers in 2016, five were women and three men. IVL has 25 team managers, of whom 16 are women and nine men.

During the year, 15 (18) permanent employees left the company to take up other positions and two people retired. New recruitment totalled 52 (21) employees.

EQUAL OPPORTUNITY AND EQUAL TREATMENT

IVL has an overall policy and plan for equal opportunity and equal treatment. The plan was developed by a representative group. Executives, managers and personnel shall all strive to ensure that IVL's activities and corporate culture are characterised by a diversity perspective and equal treatment, and thus help promote IVL's credibility as an advisor on sustainability issues.

CHARGEABILITY RATIO

During the period, the chargeability ratio was 63.6 per cent (66.3). The chargeability ratio is defined as the proportion of attendance time that is charged to the customer. The remaining – in-house – time is made up of time spent on marketing, training, technical maintenance, management and administration.

ABSENCES AND HOLIDAYS

During the year, total absences including holidays accounted for 23.3 per cent (22.7) of working hours. Sick leave represented 2.89 per cent (2.62) and holiday time taken accounted for 8.55 per cent (7.5). Leave of absence totalled 9.44 per cent (10.3), including 6.36 per cent (7.0) parental leave. Working hours are defined as the number of hours worked, including holidays and overtime worked, less absence owing to illness, child's illness, holiday, parental leave or other leave of absence and compensatory leave taken. The same calculation method is used for the figures on the average number of salaried full-year position quoted in Note 7 Personnel expenses.

SKILLS DEVELOPMENT

An ambition of IVL is to provide its employees with at least two days of skills development a year and to follow up such activities continuously. In 2016, the average time spent on skills development was 3.1 days/employee.

An internal project management training programme is provided by IVL's project department, which trained a total of 78 employees on 13 occasions. Practically all work at IVL takes place in project form, and training is designed to further professionalise project management. During 2016, the project department planned and conducted sales training for 12 employees. In 2016, a new experiential exchange initiative was carried out in the form of breakfast meetings for 83 project managers tied to the management system's main process, the project process.

ATTRACTIVE WORKPLACE

IVL conducts a thorough employee survey every two years and a less extensive pulse measurement every other year. In 2016, a pulse measurement was conducted where the two question areas of the team index and management index were followed up. In terms of the team index/working climate, IVL is essentially on a par with the benchmark while the management index is slightly below the benchmark.

One of IVL's strengths is still the respect from one's immediate manager and between colleagues, but challenges remain as to being clearer. All teams go through their results and discuss the development opportunities associated with the results. The results are also followed up in the Work Environment Committee and the management group.

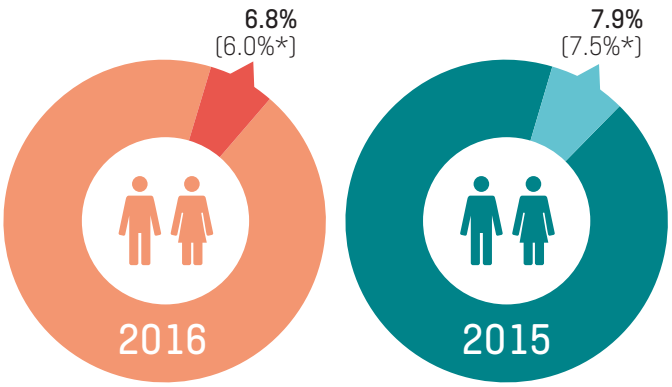
WORK ENVIRONMENT

IVL's systematic focus on the work environment is conducted via delegated responsibilities and annual work environment plans prepared in cooperation with the Work Environment Committee and then approved by the company's management group.

The work environment plan is based on improvement activities that build on, for example, the results from the employee survey, safety inspections and amended or more stringent legal requirements. Safety inspections are conducted at the company's facilities twice a year. Ergonomic safety inspections are also conducted annually in the presence of an ergonomist from the company health service. In 2016, the Work Environment Committee was revamped and it is now a common committee for all of IVL's workplaces in Sweden. The Work Environment Committee is convened once every quarter.

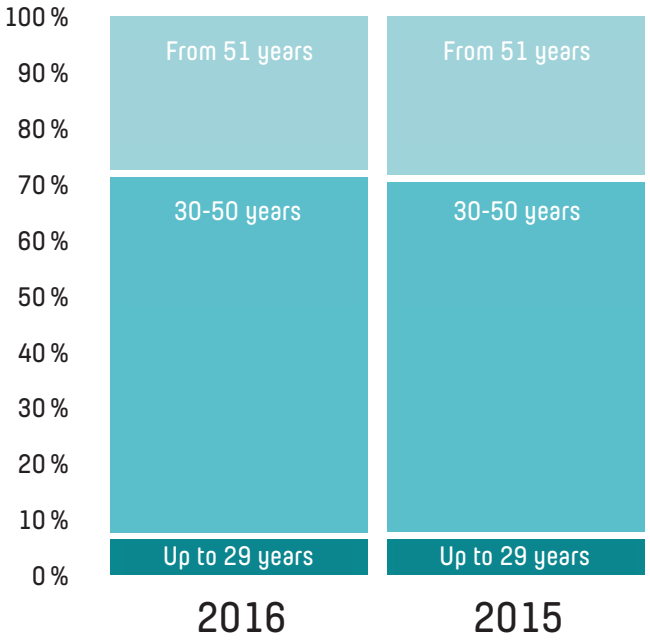
OTHER PERSONNEL PER 31 DECEMBER

Employee turnover



Percentage of employees who quit in relation to average number employed during the year.
* Pension excluded

Distribution by age

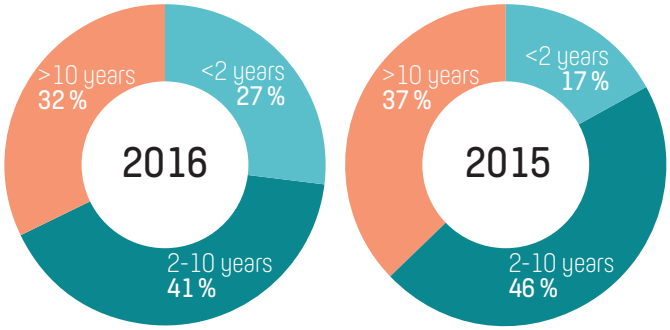


The average age is 44.3 years (43.5)

Key figures per employee

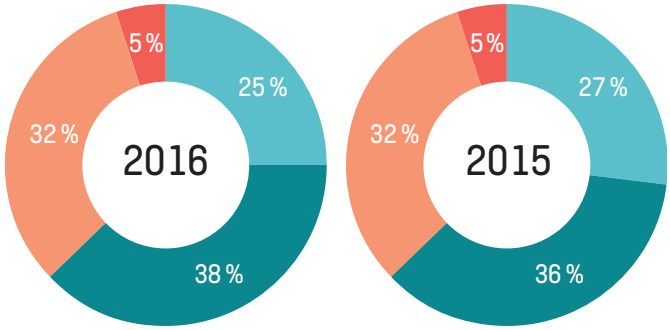
SEK 000s	2016	2015
Turnover excl. expenses	1 067	1 098
Payroll costs	680	652
Profit after financial items	0	31

Length of service



The average period of employment is 10.6 years (10).

Education



- Ph.D.
- Other academic education
- M.Sc. in Engineering
- Secondary school or post-secondary school

EQUITY

GROUP	Share capital	Other equity including profit/loss for the year	Total
Opening balance	7,000	76,900	83,900
Translation difference		-78	-48
Net profit/loss for the year		-100	-100
Closing balance	7,000	76,722	83,722

PARENT COMPANY	Share capital	Statutory reserve	Fund for development expenditures	Retained earnings	Net profit/loss for the year	Total
Opening balance	7,000	1,400	-	45,539	3,067	57,006
Appropriation of profits by AGM				3,067	-3,067	
Allocation to fund for development expenditures			1,326	-1,326		
Net profit/loss for the year					-359	-359
Closing balance	7,000	1,400	1,326	47,280	-359	56,647

PROPOSED APPROPRIATION OF PROFIT

Available for distribution by the Annual General Meeting (SEK 000s):	
Retained earnings	47,280
Net profit/loss for the year	-359
Total	46,921

The Board of Directors and the CEO propose that the profit be distributed as follows (SEK 000s)	
to be carried forward	46,921
Total	46,921

For more information on the company's and the Group's financial position and performance for the financial year on 31 December 2016, see the following income statements, balance sheets, statements of cash flows and notes to the financial statements.

INCOME STATEMENTS

SEK 000s		GROUP		PARENT COMPANY	
Operating income		**2016**	**2015**	**2016**	**2015**
Net turnover	Note 3	294,741	274,232	292,570	272,812
Change in work in progress	Note 4	-21,453	-22,073	-20,719	-19,856
Other operating income		112	155	223	150
		273,400	**252,314**	**271,963**	**253,106**
Operating expenses					
Project expenses		-34,599	-37,857	-34,599	-37,857
Other external expenses	Note 6	-58,245	-50,300	-57,767	-49,924
Personnel costs	Note 7	-176,006	-154,839	-175,314	-154,224
Depreciation of tangible assets and amortisation of intangible assets	Note 8	-4,837	-4,349	-4,777	-4,334
		-273,687	**-247,345**	**-272,457**	**-246,339**
Operating profit/loss		**-287**	**4,969**	**-494**	**6,767**
Profit/loss from financial items					
Interest income	Note 9	630	517	626	500
Interest expense	Note 9	-87	-94	-86	-94
Profit/loss after financial items		**256**	**5,392**	**46**	**7,173**
Appropriations	Note 10			-	-2,926
Income taxes on profit for year	Note 11	-356	-1,375	-405	-1,180
NET PROFIT/LOSS FOR YEAR		**-100**	**4,017**	**-359**	**3,067**

BALANCE SHEETS

		GROUP	
SEK 000s		2016	2015
ASSETS			
NON-CURRENT ASSETS			
Intangible non-current assets	Note 12		
Capitalised software development costs		7,808	6,353
Goodwill		877	116
Tangible non-current assets	Note 13		
Machinery and equipment		26,901	23,415
Financial non-current assets	Note 14		
Other securities held as non-current assets		5	5
Total non-current assets		**35,591**	**29,889**
CURRENT ASSETS			
Current receivables			
Accounts receivable		57,658	50,618
Receivables from Group companies		14,463	10,722
Tax assets		5,242	3,632
Other receivables		963	749
Income earned but not invoiced	Note 5	7,597	5,142
Prepaid expenses	Note 15	7,151	6,055
Total current receivables		**93,074**	**76,918**
Short-term investments	Note 20	**27,579**	**26,968**
Cash and bank balances	Note 19	**49,377**	**63,019**
Total current assets		**170,030**	**166,905**
TOTAL ASSETS		**205,621**	**196,794**
EQUITY AND LIABILITIES			
Equity			
Share capital (7000 shares)		7,000	7,000
Other equity including profit/loss for the year		76,722	76,900
Total equity		**83,722**	**83,900**
Provisions	Note 16	**7,175**	**7,306**
Non-current liabilities			
Liabilities to credit institutions	Note 18	**2,227**	**2,487**
Current liabilities			
Liabilities to credit institutions	Note 18	2,575	1,655
Work in progress on behalf of others	Note 4	60,442	61,371
Accounts payable		14,617	15,482
Other liabilities		10,774	9,379
Income invoiced but not earned	Note 5	7,256	3,338
Accrued expenses	Note 17	16,833	11,876
Total current liabilities		**112,497**	**103,101**
TOTAL EQUITY AND LIABILITIES		**205,621**	**196,794**

BALANCE SHEETS

		PARENT COMPANY	
SEK 000s		2016	2015
ASSETS			
NON-CURRENT ASSETS			
Intangible non-current assets	Note 12		
Capitalised software development costs		6,811	5,485
Goodwill		877	116
Tangible non-current assets	Note 13		
Machinery and equipment		22,055	19,209
Financial non-current assets			
Group companies	Note 14	1,237	1,237
Other securities held as non-current assets	Note 14	5	5
Total non-current assets		**30,985**	**26,052**
CURRENT ASSETS			
Current receivables			
Accounts receivable		56,014	48,816
Receivables from Group companies		16,480	12,610
Tax assets		5,284	3,700
Other receivables		176	56
Income earned but not invoiced	Note 5	7,597	5,142
Prepaid expenses	Note 15	7,145	6,055
Total current receivables		**92,696**	**76,379**
Short-term investments	Note 20	**27,579**	**26,968**
Cash and bank balances	Note 19	**46,654**	**61,481**
Total current assets		**166,929**	**164,828**
TOTAL ASSETS EQUITY AND LIABILITIES		**197,914**	**190,880**
Equity			
Restricted equity			
Share capital	Note 21	7,000	7,000
Statutory reserve		1,400	1,400
Fund for development expenditures		1,326	-
Total restricted equity		**9,726**	**8,400**
Non-restricted equity			
Retained earnings		47,280	45,539
Net profit/loss for the year		-359	3,067
Total non-restricted equity		**46,921**	**48,606**
Total equity		**56,647**	**57,006**
Untaxed reserves	Note 10	**15,292**	**15,292**
Current liabilities			
Work in progress on behalf of others	Note 4	77,107	78,852
Accounts payable		14,615	15,304
Other liabilities		10,774	9,370
Income invoiced but not earned	Note 5	7,256	3,338
Accrued expenses	Note 17	16,223	11,718
Total current liabilities		**125,975**	**118,581**
TOTAL EQUITY AND LIABILITIES		**197,914**	**190,880**

STATEMENT OF CASH FLOWS

	GROUP		PARENT COMPANY	
SEK 000s (Direct method)	2016	2015	2016	2015
OPERATING ACTIVITIES				
Profit/loss after financial items	256	5,392	46	7,173
Adjustment for non-cash items	10,030	3,202	9,715	3,288
Income taxes paid	-1,966	-2,568	-1,989	-2,367
Cash flow from operating activities before changes in working capital	**8,320**	**6,026**	**7,712**	**8,094**
CASH FLOW FROM CHANGES IN WORKING CAPITAL				
Increase/decrease in receivables	-10,995	148	11,188	773
Decrease in accounts payable	-865	-1,328	-689	-1,083
Increase/decrease in other liabilities	2,315	-1,976	1,404	-1,451
Decrease/increase in advance payments for work in progress	-929	23,171	-1,748	20,824
Cash flow from operating activities	**-2,154**	**26,041**	**-4,509**	**27,157**
INVESTING ACTIVITIES				
Acquisition of intangible noncurrent assets	-2,460	-1,641	-2,279	-1,253
Acquisition of tangible noncurrent assets	-8,091	-9,644	-7,431	-9,416
Acquisition of financial noncurrent assets			-	-7
Acquisition of shortterm investments	-611	-473	-611	-473
Cash flow from investing activities	**-11,162**	**-11,758**	**-10,321**	**-11,149**
FINANCING ACTIVITIES				
Cash flow from financing activities	**-260**	**722**		
Cash flow for the year	**-13,576**	**15,005**	**-14,830**	**16,008**
Opening cash and bank balances	**63,019**	**48,004**	**61,481**	**45,475**
Exchange rate differences in cash and cash equivalents	**-66**	**10**	**3**	**-2**
Closing cash and bank balances	**49,377**	**63,019**	**46,654**	**61,481**

NOTES

to the financial statements and accounting principles

NOTE 1

ACCOUNTING PRINCIPLES

1.1 COMPLIANCE WITH STANDARDS AND LEGISLATION

The consolidated accounts have been prepared in accordance with BFNAR 2012:1 *Annual Report and Consolidated Accounts (K3)*.

In cases where guidance is not available from the K3 regulation, it has been obtained from the Swedish Annual Accounts Act (1995:1554).

The Parent Company applies the same accounting principles as the Group, other than is indicated below in the section "Parent Company's accounting principles". Divergences between the Parent Company's and the Group's principles arise from limitations in the applicability of K3 to the Parent Company through the requirements of the Annual Accounts Act and, in some cases, tax considerations.

1.2 BASIS OF PREPARATION OF THE FINANCIAL STATEMENTS OF THE PARENT COMPANY AND THE GROUP

The Parent Company's functional currency is the Swedish krona (SEK), which is also the reporting currency for the Parent Company and the Group. The financial statements are therefore presented in SEK. Assets and liabilities are recognised at historical cost, with the exception of certain financial assets and liabilities that are measured at fair value.

The preparation of financial statements under K3 requires the company management to make judgements, estimates and assumptions that affect application of the accounting principles and the amounts recognised for assets, liabilities, income and expenses. The estimates and assumptions are based on historical experience and a number of other factors that in the prevailing circumstances are judged to be reasonable. The results of these estimates and assumptions are then used to assess the carrying amounts for assets and liabilities that are not otherwise revealed clearly from other sources. The actual outcome may differ from these estimates and judgements. Typically, these estimates and assumptions are made during preparation of the year-end and mid-year accounts. As a result of changes at the company or in its business environment, it may become necessary to revise these estimates and assumptions.

1.3 CHANGES IN ACCOUNTING PRINCIPLES AND DISCLOSURE REQUIREMENTS

In 2016, no new accounting policies with any impact on the Group entered into force.

1.4 CLASSIFICATION, ETC.

Non-current assets and financial liabilities of the Parent Company and the Group essentially only consist of amounts expected to be recovered or paid after more than 12 months from the balance sheet date. Current assets and current liabilities in the Parent Company and the Group essentially only consist of amounts expected to be recovered or paid within 12 months calculated from the balance sheet date.

1.5 PRINCIPLES OF CONSOLIDATION

Subsidiaries are entities over which IVL exercises a controlling influence. A controlling influence consists of a right, directly or indirectly, to control the financial and operational strategies of another company in order to gain economic benefits. In establishing whether a controlling influence exists, account shall be taken of shares with potential voting rights that may be used or converted without delay.

Subsidiaries are accounted for using the proportional method. Under this method, as large a proportion as possible of the owned company's income and expenses, and of its assets and liabilities, are recognised in the consolidated accounts.

The reason for choosing this principle of consolidation is that IVL was involved in the original establishment of Group companies and did not acquire them at a surplus or deficit value.

Intra-Group receivables and liabilities, income and expenses and unrealised gains or losses arising from transactions between Group companies are eliminated in their entirety during preparation of the consolidated accounts.

1.6 FOREIGN CURRENCIES

Foreign currency transactions are translated to the functional currency at the exchange rate prevailing on the transaction date. Monetary assets and liabilities in foreign currencies are translated to the functional currency at the exchange rate prevailing on the balance sheet date.

Exchange rate differences arising on translation are recognised in the income statement. Non-monetary assets and liabilities recognised at historical cost are translated at the exchange rate on the transaction date. Non-monetary assets and liabilities recognised at fair value are translated to the functional currency at the rate prevailing at the time of measurement at fair value; any exchange rate difference is then recognised in the same way as for other changes in value for the asset or liability. The functional currency is the currency of the countries in which the companies included in the Group conduct their operations. The functional and reporting currency of the Parent Company is the Swedish krona (SEK). The reporting currency of the Group is the SEK.

Assets and liabilities of foreign operations are translated to SEK at the exchange rate prevailing on the balance sheet date. Income and expenses in foreign operations are translated to SEK at an average rate that is an approximation of the rates at the times of the respective transactions. Any translation differences arising during translation of foreign net investments are recognised in other comprehensive income.

1.7 INCOME

The percentage of completion method is used for all projects where the outcome can be calculated reliably. Projects are conducted on an open account basis, in which income is recognised as the work is performed and normally invoiced to the customer the following month. In cases where a fixed price is agreed, the income is recognised when the work is essentially completed, according to the so-called percentage of completion method. On-going projects not yet invoiced are valued in the balance sheet in an amount of the directly paid expenses plus indirect expenses less invoiced partial payments.

If it is probable that the total expense for the project will exceed the total income from the project, the anticipated loss is immediately recognised in its entirety as a cost. Income is not recognised if it appears probable that the economic benefits will not accrue to the Group. If there is significant uncertainty regarding a payment or associated costs, no income is recognised.

In grant-funded projects in which IVL functions as a contractual partner with the research funder and allocates project funding to other participants in the projects, such funds are not recognised as income but accounted for directly under the heading of work in progress on behalf of others. As a result, the invoicing and costs of expenses are deducted from the funds received, which are then paid out to other project partners.

1.8 OPERATING EXPENSES AND FINANCIAL INCOME AND EXPENSE

The Parent Company's costs under operating leases are recognised in the income statement on a straight-line basis over the term of the lease. Benefits acquired in connection with the signing of an agreement are reported as a part of the total leasing cost in the income statement. Variable charges are expensed in the periods in which they are incurred.

Minimum lease fees under finance leases in the Group are allocated between interest expense and amortisation of the outstanding liability. Interest expense is distributed over the term of the lease so that each accounting period is charged with an amount corresponding to a fixed interest rate for the liability recognised in each period. Variable charges are expensed in the periods in which they are incurred.

Financial income and expense consist of interest income from bank deposits and receivables and interest expense to suppliers.

1.9 RECEIVABLES AND LIABILITIES

Accounts receivable are recognised in the amounts expected to be received, that is, after deduction of bad debts, which are assessed on a case-by-case basis. Impairments of accounts receivable are recognised under the heading of operating expenses. Other receivables are classified as current receivables if outstanding for more than a year and as other receivables if the period is less than that. Cash and cash equivalents consist of cash and demand deposit accounts with banks and similar institutions.

Loans and other financial liabilities, including accounts payable, are measured at accumulated acquisition cost. Accounts payable have a short expected term and are measured undiscounted at the nominal amount. Non-current liabilities have an expected term of more than a year, while current liabilities have a term of less than a year.

1.10 TANGIBLE NON-CURRENT ASSETS

1.10.1 Owned assets

Tangible non-current assets are recognised as assets on the balance sheet if it is probable that future economic benefits will accrue to the company and that the acquisition cost for the asset may be calculated reliably. Tangible non-current assets are recognised in the Group at acquisition cost after deduction of accumulated depreciation and any impairment losses. Acquisition cost includes the purchase price and costs directly attributable to putting the asset into place and in a condition such that it is fit for use in accordance with the intention of the acquisition.

The carrying amount for a tangible non-current asset is removed from the balance sheet upon scrapping or disposal or when no future economic benefits are expected from the use or the scrapping or disposal of the asset. Any gain or loss arising from disposal or scrapping of an asset is determined as the difference between the selling price and the carrying amount of the asset, less direct costs of sale. Any gain or loss arising is recognised as operating income/expense.

1.10.2 Leased assets
In the consolidated accounts, leases are classified as either finance or operating leases. A finance lease exists when the economic risks and benefits associated with ownership are essentially transferred to the lessee; where this is not the case, the lease is an operating lease. Assets leased under finance leases are recognised as assets on the consolidated balance sheet. The obligation to pay future lease fees is recognised under non-current and current liabilities. The leased assets are depreciated according to plan, while the lease fees are recognised as interest and amortisation of the liabilities. Under operating leases, the lease fee is recognised as an expense on a straight-line basis over the term of the lease.

1.11 INTANGIBLE ASSETS

1.11.1 Goodwill
Goodwill is defined as the difference between the acquisition cost of operating acquisitions and the fair value of assets acquired, liabilities assumed and contingent liabilities.

Goodwill is allocated to cash-generating units and groups of cash-generating units and is tested annually for impairments. Goodwill is thus measured at acquisition cost less any accumulated impairments.

1.11.2 Capitalised software development costs
Other intangible assets acquired by the Group are recognised at acquisition cost, less accumulated amortisation. Subsequent expenditure on capitalised intangible assets is recognised on the balance sheet only when this results in an increase in future economic benefits associated with the specific asset to which it relates. All other expenses are recognised as costs as incurred.

1.12 IMPAIRMENT OF ASSETS AND TESTING FOR IMPAIRMENTS

The carrying amounts for the Group's assets are tested for impairment on every balance sheet date to determine whether there is any indication of impairment. If any such indication is found, the recovery value for the asset is calculated. Any impairment loss is charged to the income statement.

The recoverable amount is the fair value, less costs of sale, and value in use, whichever is the higher. In calculating the value in use, future cash flows are discounted by a discount factor that takes into account the risk-free interest rate and the risk associated with the specific asset. The recoverable amount of goodwill and other intangible assets with indefinite useful lives and intangible assets not yet ready for use is calculated annually.

At each reporting date, the company assesses whether any objective evidence exists to indicate impairment of any financial assets or group of assets. Objective evidence includes observable events that have occurred and adversely affect the possibility of recovering the acquisition cost, and a significant or prolonged decline in the fair value of an investment in a financial investment classified as a financial asset available for sale.

1.13 EMPLOYEE BENEFITS

Obligations relating to defined-contribution pension plans are recognised as an expense in the income statement as they arise. IVL does not operate any defined-benefit pension plans.

Provisions in connection with terminations of employment are recognised only if the company is demonstrably obligated to terminate employment before the normal date, or when compensation is offered as an incentive for voluntary departure. In the event that the company is obligated to terminate employment, actions shall include a detailed plan stating, at least, details of workplace, positions affected and the approximate number of employees, together with compensation amounts for each personnel category or position and the time for implementation of the plan.

1.14 PROVISIONS

Provisions are recognised in the balance sheet when the Group has an existing obligation (legal or constructive) arising from an event that has occurred and when it is probable that an outflow of financial resources will be required in order to discharge such an obligation, and when the amount can be estimated reliably.

1.15 INCOME TAXES

Income taxes consist of current and deferred tax. Income taxes are recognised in the income statement.

Current tax is tax that is to be paid or recovered for the current year, based on the tax rates enacted or in practice enacted on the balance sheet date, including adjustment of current tax attributable to earlier periods. Deferred tax is calculated using the balance sheet method, which focuses on temporary differences between the carrying amount of an asset or a liability and its taxable amount. Measurement of deferred tax is based on how the underlying assets or liabilities are expected to be capitalised or settled.

Deferred tax is based on the tax rates and tax rules enacted or in practice enacted on the balance sheet date.

1.16 PARENT COMPANY'S ACCOUNTING PRINCIPLES

The Parent Company's accounts have been prepared in accordance with BFNAR 2012:1 *Annual Report and Consolidated Accounts (K3)* and the Swedish Annual Accounts Act (1995:1554).

Differences between the accounting policies of the Group and the Parent Company:
In the Parent Company, participations in subsidiaries and associated companies are recognised using the cost method. Dividends received are recognised as income. In the Parent Company, all leases are accounted for in accordance with the rules on operating leases. In the Parent Company, untaxed reserves are recognised including deferred tax liability. In the consolidated accounts, on the other hand, untaxed reserves are divided into income tax liability and equity.

NOTE 2

SUMMARY OF FINANCIAL POSITION AND KEY RATIOS

	GROUP					PARENT COMPANY				
SEK 000s	2016	2015	2014	2013	2012	2016	2015	2014	2013	2012
TURNOVER AND PROFIT/LOSS										
Net turnover	294,741	274,232	264,488	255,353	247,827	292,570	272,812	263,272	254,200	247,139
Operating profit/loss after depreciation	-287	4,969	10,885	9,709	7,529	-494	6,767	10,325	10,555	7,874
Operating profit/loss after financial items	256	5,392	12,543	10,381	7,692	46	7,173	11,972	11,205	8,009
Profit margin, %	0.1%	2.0	4.7	4.1	3.1	0.0	2.6	4.5	4.4	3.2
CAPITAL STRUCTURE										
Non-current assets	35,591	29,889	22,950	19,999	13,803	30,985	26,052	19,709	17,092	14,420
Current assets	170,030	166,905	149,804	162,360	137,396	166,929	164,828	147,360	160,992	136,322
Equity	83,722	83,900	79,865	70,519	61,171	56,647	57,006	53,939	47,640	40,962
Untaxed reserves						15,292	15,293	12,366	9,180	6,444
Current liabilities	112,497	103,101	83,981	104,369	82,883	125,975	118,581	100,765	121,264	103,336
Non-current liabilities	2,227	2,487	1,765	1,126						
Provisions	7,175	7,306	7,143	6,355	7,145					
Total assets	205,621	196,794	172,754	182,359	155,199	197,914	190,880	167,070	178,084	150,744
Adjusted equity						68,575	68,935	63,584	54,800	45,711
Equity, mean value for year	83,811	81,883	75,192	65,845	58,530	68,754	66,260	59,192	50,226	42,292
Total capital, mean value for year	201,208	184,774	177,557	168,779	147,940	194,397	178,975	172,577	164,414	145,500
Equity ratio, %	40.7	42.6	46.2	38.7	39.4	34.6	36.1	38.1	30.8	30.3
Current ratio, mult.	1.51	1.62	1.78	1.56	1.66	1.33	1.39	1.46	1.33	1.32
PROFITABILITY										
Return on adjusted equity, %	0.2	5.1	13.0	12.3	9.7	0.1	8.4	15.8	17.4	13.7
Return on adjusted equity 5-year mean, %	8.1	11.5	9.5	8.5	8.1	11.1	13.6	11.1	8.6	7.8
Return on total capital, %	0.2	3.0	7.1	5.7	5.5	0.1	4.1	7.0	6.9	6.0
OTHER										
Investment in non-current assets	10,551	11,285	7,074	10,789	6,215	9,710	10,676	6,736	7,264	6,208
Invoicing/employee, incl. expenses	1,160	1,188	1,157	1,177	1,239	1,175	1,197	1,175	1,182	1,242
Invoicing/employee, fees and analysis	1,055	1,090	998	992	1,049	1,067	1,098	1,010	1,002	1,051
Chargeability ratio, %	63.6	66.3	66.3	66.4	66.2	63.6	66.3	66.3	66.4	66.2
Full-year employees	255	232	228	217	198	249	228	224	215	197
Payroll cost per employee	669	645	616	606	614	680	652	625	611	617

Profit margin
Profit/loss after net financial items, as % of net turnover.

Adjusted equity
Equity plus untaxed reserves, less tax at standard rate of 22%.

Equity ratio
Adjusted equity, as % of balance sheet total.

Return on equity
Profit after net financial items and after tax at a standard 22%, as % of average adjusted equity.

Return on total capital
Profit after net financial items with interest expenses added back, as % of average balance sheet total.

Chargeability ratio
Hours charged to customer, as % of total hours of attendance.

Full-year employees
The number of employees during the year, expressed as full-year positions. The actual number of employees is higher, partly because the organisation has part-time employees and partly because certain employees work during part of the year.

Current ratio
Current assets divided by current liabilities.

NOTE 3

NET TURNOVER

	GROUP		PARENT COMPANY	
SEK 000s	2016	2015	2016	2015
Net turnover by				
Invoiced fees and analysis	267,860	251,173	265,689	250,311
Invoiced expenses	26,881	22,500	26,881	22,500
Total net turnover	**294,741**	**274,232**	**292,570**	**272,811**

Of net turnover for the year, invoicing to other Group companies – comprising remuneration for co-funded research that the Company has conducted on a contract basis – accounted for 26.4% (24.4).

In addition, compensation was received from Group companies for personnel services performed.

NOTE 4

CHANGE IN WORK IN PROGRESS/ WORK IN PROGRESS ON BEHALF OF OTHERS

	GROUP		PARENT COMPANY	
SEK 000s	2016	2015	2016	2015
Project costs	434,651	477,165	417,773	459,554
Advance invoicing	-495,093	-538,536	494,880	-538,406
Carrying amount	**60,442**	**61,371**	**77,107**	**78,852**
Change recognised in				
Income statement	21,453	22,073	20,719	19,856
Balance sheet	-22,382	1,098	-22,464	968
Total change in work in progress for year	**-929**	**23,171**	**-1,745**	**20,824**

NOTE 5

INCOME EARNED BUT NOT INVOICED/ INCOME INVOICED BUT NOT EARNED

	GROUP		PARENT COMPANY	
SEK 000s	2016	2015	2016	2015
Income earned but not invoiced				
Project costs	62,478	45,193	62,478	45,193
Advance invoicing	-54,881	-40,001	-54,881	-40,001
Carrying amount	**7,597**	**5,142**	**7,597**	**5,142**
Income invoiced but not earned				
Project costs	20,560	28,612	20,560	28,612
Advance invoicing	-27,816	-31,950	-27,816	-31,950
Carrying amount	**7,256**	**3,338**	**7,256**	**3,338**

NOTE 6

OTHER EXTERNAL EXPENSES

Auditor's fees

	GROUP		PARENT COMPANY	
SEK 000s	2016	2015	2016	2015
R3 Revisionbyrå KB				
Audit assignment	317	278	284	250
Other services	14	39	14	39
Rödl & Partner Nordic AB				
Audit assignment	-		-	-
Other auditing services	-		-	-
Other services	142	168	142	168
Other auditors				
Audit assignment	13	13	5	5
Total	**486**	**498**	**445**	**462**

Lease costs

Lease fees for operating leases during 2016 totalled SEK 16,938 thousand (15,140). Lease fees include charges for leases on properties, company cars used by the company's personnel, computers and some office equipment. The costs relating to future lease payments on these contracts are payable in the following years:

SEK 000s	2017	2018	2019	2020	2021
Other lease fees	2,575	1,429	799		
Office rent	15,070	17,296	20,055	20,356	20,662
Total	**17,645**	**18,725**	**20,854**	**20,356**	**20,662**

NOTE 7

PERSONNEL EXPENSES, GROUP

	2016		2015	
SEK 000s	Salaries and other remuneration	Social costs (of which pension costs)	Salaries and other remuneration	Social costs (of which pension costs)
Board and CEO	2,452	1,663	2,468	1,469
		(742)		(560)
Other employees	112,408	53,779	98,628	47,081
		(18 895)		(16 735)
Total	**114,861**	**55,442**	**101,096**	**48,550**
		(19 637)		**(17 295)**

AVERAGE NUMBER OF EMPLOYEES* IN THE GROUP DURING THE YEAR:

	2016			2015		
	MEN	WOMEN	TOTAL	MEN	WOMEN	TOTAL
Stockholm	68	51	119	66	55	121
Gothenburg	43	65	108	40	53	93
Lysekil	2	1	3	0	2	2
Malmö	2	9	11	1	3	4
Beijing	4	6	10	4	5	9
Tianjin	3	1	4	2	1	3
Total	**122**	**133**	**255**	**113**	**119**	**232**

PERSONNEL EXPENSES PARENT COMPANY

	2016		2015	
SEK 000s	Salaries and other remuneration	Social costs (of which pension costs)	Salaries and other remuneration	Social costs (of which pension costs)
Board and CEO	2,363	1,663 (742)	2,389	1,445 (560)
Other employees	111,963	53,698 (18,895)	98,275	47,037 (16,735)
Total	**114,326**	**55,361 (19,637)**	**100,664**	**48,482 (17,295)**

AVERAGE NUMBER OF EMPLOYEES* IN THE PARENT COMPANY DURING THE YEAR:

	2016			2015		
	MEN	WOMEN	TOTAL	MEN	WOMEN	TOTAL
Stockholm	68	51	119	66	55	121
Gothenburg	43	65	108	40	53	93
Lysekil	2	1	3	0	2	2
Malmö	2	9	11	1	3	4
Beijing	2	5	8	4	4	8
Total	**118**	**131**	**249**	**111**	**117**	**228**

** Defined as the number of salaried full-year employees*

NUMBER OF EMPLOYEES IN COMPANY'S MANAGEMENT GROUP (of whom, in executive management):

	2016	2015
Men	4 (4)	4 (4)
Women	8 (1)	8 (1)

BOARD MEMBERS

	2016	2015
Men	5	5
Women	5	5

SENIOR EXECUTIVES

Parent Company
In accordance with a decision by the AGM, Board of Directors' fees totalling SEK 461 thousand (515), including social security expenses, were recognised as costs. Of this amount, SEK 94 thousand (94), excluding social security expenses, was paid to the Chair.

The period of notice for CEO of the Parent Company is 12 months and severance pay in an amount corresponding to 12 times the CEO's fixed monthly salary is due if employment is terminated by the company. Should the CEO's role or areas of responsibility be altered as a result of material changes in the company's operations or as a result of any change in the ownership structure affecting the majority of the company's shares, the CEO is entitled to terminate his/her employment by giving six months' notice and is entitled to receive severance pay corresponding to 18 times his/her fixed monthly salary. The CEO is entitled to retire from the age of 62 years. The CEO's pension is of the defined-contribution type and an annual allocation is made in amount corresponding to 35 per cent of the salary for the particular year, including company car benefit. At retirement on attainment of the age of 62 years, retirement pension premium payments will be paid as if the CEO had worked until attaining the age of 65 years.

Group
The CEO of the joint venture company has an employment relationship of 1 year from 1 July 2016. There is no entitlement to any pension other than statutory pension.

NOTE 8

DEPRECIATION OF TANGIBLE ASSETS AND AMORTISATION OF INTANGIBLE ASSETS

Group and Parent Company
Capitalised expenditure for software development is amortised according to plan annually at a rate of 20 per cent of acquisition cost, from the date of completion during the year.

Business goodwill is amortised at 20 per cent of acquisition cost. Any impairment is assessed on the basis of the present value of future surpluses.

Machinery and equipment is depreciated according to plan at an annual rate of 10 to 20 per cent of acquisition cost, from the date of acquisition by the Parent Company during the year.

Machinery and equipment is also depreciated according to plan on the basis of the remaining economic life of the asset, in accordance with a measurement conducted specifically for an international joint venture.

NOTE 9

INTEREST INCOME AND EXPENSES GROUP AND PARENT COMPANY

The Group recognises bank interest income of SEK 614 thousand (504), and the Parent Company SEK 610 thousand (492), and of the interest expense in the Parent Company SEK 38 thousand (32) pertains to Group companies.

NOTE 10

APPROPRIATIONS AND UNTAXED RESERVES

	PARENT COMPANY	
SEK 000s	31 Dec 2016	31 Dec 2015
Opening balance, untaxed reserves	**15,292**	**12,366**
Change in acc. depreciation acc. to plan (machinery & equipment)	-	1,493
Change in tax allocation reserve	-	1,433
Total appropriations	**-**	**2,926**
Closing balance, untaxed reserves	**15,292**	**15,292**

NOTE 11

INCOME TAXES ON PROFIT FOR YEAR

	GROUP		PARENT COMPANY	
ESTIMATE OF EFFECTIVE TAX RATE, SEK 000s	2016	2015	2016	2015
Profit/loss before tax	**256**	**5,392**	**47**	**4,247**
Tax at current tax rate, 22%	56	969	11	935
Non-taxable income	-33	-77	-33	-77
Non-deductible expenses	227	153	227	153
Standard income, tax allocation reserves	22	-	21	-
Standard income, shares and funds	23	-	23	-
Tax from previous year(s)	13	17	13	17
Foreign tax expense	208	152	143	152
Deferred tax	-161	161	-	-
Recognised effective tax	**356**	**1,375**	**405**	**1,180**
Recognised effective tax rate	**139.2%**	**25.5%**	**881.1%**	**27.8%**

NOTE 12

INTANGIBLE NON-CURRENT ASSETS

	DEVELOPMENT EXPENDITURES		GOODWILL	
GROUP, SEK 000s	31 Dec 2016	31 Dec 2015	31 Dec 2016	31 Dec 2015
Opening acquisition cost	**7,630**	**5,989**	**1,966**	**1,966**
Acquisitions for the year	1,507	1,641	953	-
Closing accumulated acquisition cost	**9,137**	**7,630**	**2,919**	**1,966**
Opening amortisation	-1,277	-1,277	-1,850	-1,817
Amortisation for year	-53	-		-33
Closing accumulated amortisation	**-1,329**	**-1,277**	**-2,042**	**-1,850**
Closing residual value according to plan	**7,808**	**6,353**	**877**	**116**

	DEVELOPMENT EXPENDITURES		GOODWILL	
PARENT COMPANY, SEK 000s	31 Dec 2016	31 Dec 2015	31 Dec 2016	31 Dec 2015
Opening acquisition cost	**6,762**	**5,509**	**1,966**	**1,966**
Acquisitions for the year	1,326	1,253	953	-
Closing accumulated acquisition cost	**8,088**	**6,762**	**2,919**	**1,966**
Opening amortisation	-1,277	-1,277	-1,850	-1,817
Amortisation for year	-	-		-33
Closing accumulated amortisation	**1,277**	**-1,277**	**-2,042**	**-1,850**
Closing residual value according to plan	**6,811**	**5,485**	**877**	**116**

NOTE 13

TANGIBLE NON-CURRENT ASSETS

	GROUP		PARENT COMPANY	
SEK 000s	31 Dec 2016	31 Dec 2015	31 Dec 2016	31 Dec 2015
Opening acquisition cost	**86,780**	**104,864**	**71,357**	**100,661**
Purchases for year incl. finance leases	8,091	9,644	7,431	9,416
Exchange difference	4	9	-	-
Retirements for the year	-	-38,720	-	-38,720
Closing accumulated acquisition cost	**83,892**	**75,797**	**78,788**	**71,357**
Opening depreciation	**-52,382**	**-86,780**	**-52,148**	**-86,568**
Exchange difference	-6	-8	-	-
Retirements for the year	-	38,720	-	38,720
Depreciation for year	**-4,603**	**-4,314**	**-4,585**	**-4,301**
Closing accumulated depreciation for equipment	**-56,991**	**-52,382**	**-56,733**	**-52,148**
Closing residual value according to plan	**26,901**	**23,415**	**22,055**	**19,209**

Finance leases
In the Group, equipment held under finance leases is recognised in a carrying amount of SEK 4,802 thousand (4,142). The headings of current and non-current liabilities in the Group's balance sheet include future payments in connection with lease commitments recognised as liabilities. See also Note 18, "Liabilities to credit institutions".

NOTE 14

GROUP COMPANIES AND OTHER SECURITIES HELD AS NON-CURRENT ASSETS

Shares and participations

	GROUP			PARENT COMPANY	
Company, SEK 000s	Number	%	Book	Quotient value	Book
Participation in IVL Svenska Miljöinstitutet AB's Personnel Foundation	1		5	5	5
Basta Online AB	600	60%	-	60	60
EPD International AB	500	100%	-	50	50
Sino-Swedish (Tianjin) Environmental Technology Development Co., Ltd	1	50%	-	581	581
IVL Environmental Technologies (Beijing) Company Ltd	1	100%	-	546	546
Total			**5**	**1,242**	**1,242**

NOTE 15

PREPAID EXPENSES

	GROUP		PARENT COMPANY	
SEK 000s	31 Dec 2016	31 Dec 2015	31 Dec 2016	31 Dec 2015
Rent for offices and other premises	3,830	4,013	3,830	4,013
Other prepaid expenses	3,320	2,042	3,315	2,042
Closing balance	**7,150**	**6,055**	**7,145**	**6,055**

NOTE 16

PROVISIONS

	GROUP		PARENT COMPANY	
SEK 000s	31 Dec 2016	31 Dec 2015	31 Dec 2016	31 Dec 2015
Deferred tax liability	7,175	7,306		
Closing balance	**7,175**	**7,306**		

IVL takes the view that deferred tax due for payment in 2017 will be low, as IVL's investment levels will continue to be high and interest rates low. As a result, use of tax allocation reserves for consolidation purposes will continue to be advantageous. In the subsequent five-year period, the tax allocation reserves for 2012, 2013, 2014 and 2015, totalling SEK 9,594 thousand, will in any event be dissolved.

NOTE 17

ACCRUED EXPENSES

	GROUP		PARENT COMPANY	
SEK 000s	31 Dec 2016	31 Dec 2015	31 Dec 2016	31 Dec 2015
Holiday and overtime liabilities	7,941	4,791	7,941	4,791
Accrued social costs	6,844	5,997	6,844	5,997
Other accrued expenses	2,048	1,088	1,438	929
Closing balance	**16,833**	**11,876**	**16,223**	**11,717**

NOTE 18

LIABILITIES TO CREDIT INSTITUTIONS

	GROUP	
SEK 000s	31 Dec 2016	31 Dec 2015
Non-current liabilities		
Opening balance	2,487	1,765
Change in liabilities to credit institutions	-260	722
Closing balance	**2,227**	**2,487**
Current liabilities		
Opening balance	1,655	2,176
Change in liabilities to credit institutions	919	-521
Closing balance	**2,574**	**1,655**

NOTE 19

PLEDGED ASSETS AND CONTINGENT LIABILITIES, GROUP AND PARENT COMPANY

SEK 000s	31 Dec 2016	31 Dec 2015
Pledged assets for liabilities to credit institutions		
Chattel mortgages	5,000	5,000
Total	**5,000**	**5,000**
Contingent liabilities	**None**	**None**

NOTE 20

SHORT-TERM INVESTMENTS, GROUP AND PARENT COMPANY

	GROUP		PARENT COMPANY	
SEK 000s	31 Dec 2016	31 Dec 2015	31 Dec 2016	31 Dec 2015
Opening balance	26,968	26,492	26,968	26,492
Change in value	611	476	611	476
Closing balance	27,579	26,968	27,579	26,968

NOTE 21

DISCLOSURES ON SHARE CAPITAL, PARENT COMPANY

	31 DEC 2016		31 DEC 2015	
SEK 000s	Number	Quotient value per share	Number	Quotient value per share
Value/Number at beginning of year	7,000	1,000	7,000	1,000
Value/Number at end of year	7,000	1,000	7,000	1,000

NOTE 22

APPROPRIATION OF PROFIT OR LOSS, PARENT COMPANY

	31 Dec 2016	31 Dec 2015
Retained earnings	47,280	45,539
Net profit/loss for the year	-359	3,067
Total	**46,921**	**48,606**
To be carried forward	46,921	48,606

NOTE 23

SIGNIFICANT EVENTS AFTER THE END OF THE FINANCIAL YEAR

Evacuation and renovation of existing offices will take place in 2017-2018.

Stockholm, 7 March 2017

Annika Helker Lundström,
Chair of the Board

Gunilla Saltin | Peter Nygårds | Johan Kuylenstierna

Karin Byman | Bo Olsson | Christer Forsgren

Maria Ågren | Anders Björk, Employee Representative | Pernilla Bengtsson, Employee Representative

Tord Svedberg, CEO

Our audit report was submitted on
R3 Revisionsbyrå KB

Tomas Nöjd,
Authorised Public Accountant

Christina Kallin,
Authorised Public Accountant

AUDIT REPORT

To the General Meeting of Shareholders in IVL Svenska Miljöinstitutet AB CIN 556116-2446

STATEMENT ON THE ANNUAL REPORT AND CONSOLIDATED ACCOUNTS

OPINIONS

We have conducted an audit of the annual accounts and consolidated accounts of IVL Svenska Miljöinstitutet AB for the year 2016. The company's annual accounts and consolidated accounts are included in this document on pages 50-75.

In our view, the annual accounts and the consolidated accounts have been prepared in accordance with the Swedish Annual Accounts Act and provide in all material respects a true and fair view of the Parent Company's and the Group's financial position on 31 December 2016 and of its financial results and cash flows for the year in accordance with the Swedish Annual Accounts Act. The statutory administration report is consistent with the other parts of the annual accounts and consolidated accounts.

We therefore recommend to the Annual General Meeting that the Parent Company and consolidated income statements and balance sheets be adopted.

GROUNDS FOR OPINIONS

We conducted our audit in accordance with International Standards on Auditing (ISA) and generally accepted auditing standards in Sweden. Our responsibility according to these standards is described in more detail in the section on "Auditor's responsibility". We are independent in relation to the Parent Company and Group in accordance with generally accepted auditing standards in Sweden and have otherwise fulfilled our professional ethics responsibility according to these requirements.

We believe that the accounting evidence we have obtained provides an adequate and appropriate basis for our opinions.

INFORMATION OTHER THAN THE ANNUAL ACCOUNTS AND CONSOLIDATED ACCOUNTS

It is the Board and CEO who have the responsibility for the other information. The other information consists of IVL Swedish Environmental Research Institute's Annual Report 2016 (not including the annual accounts, consolidated accounts and our audit report regarding them).

Our opinion regarding the annual accounts and consolidated accounts does not comprise this information and we make no statement confirming this other information.

In connection with our audit of the annual accounts and consolidated accounts, it is our responsibility to read the information identified above and consider if the information to a material extent is inconsistent with the annual accounts and consolidated accounts. In this review, we also take into account the information we collected otherwise during the audit and assess if the information otherwise appears to contain material misstatements.

If we draw the conclusion based on the work done regarding this information that the other information contains a material misstatement, we are obliged to report it. We have nothing to report in this respect.

RESPONSIBILITIES OF THE BOARD OF DIRECTORS AND THE CEO

It is the Board of Directors and the CEO who are responsible for the preparation of the annual accounts and consolidated accounts and that they provide a true and fair view according to the Annual Accounts Act. The Board and CEO are also responsible for the internal control that they deem to be necessary to prepare annual accounts and consolidated accounts that do not contain any material misstatement, whether due to error or impropriety.

In preparing the annual accounts and consolidated accounts, the Board and CEO are responsible for the assessment of the company's and the Group's ability to continue the operations. They provide information, when appropriate, concerning conditions that may affect the ability to continue operations and to use the going concern assumption. The going concern assumption is not, however, applied if the Board and CEO intend to liquidate the company, cease operations or have no realistic alternative than to do either.

AUDITOR'S RESPONSIBILITY

Our objectives are to achieve a reasonable degree of certainty whether or not the annual accounts and consolidated accounts as a whole contain any material misstatements, whether due to error or impropriety, and to provide an audit report that contains our opinions. Reasonable certainty is a high degree of certainty, but is no guarantee that an audit done according to ISA and generally accepted auditing standards in Sweden will always discover a material misstatement if such exists. Misstatements can arise due to impropriety or error and are considered to be material if they individually or together can reasonably be expected to affect financial decisions that users make based on the annual accounts and consolidated accounts.

As a part of an audit according to ISA, we use professional judgement and have a professionally sceptical approach in the entire audit. Moreover:

- we identify and assess the risks of material misstatements in the annual accounts and consolidated accounts, whether they are due to impropriety or error, formulate and carry out auditing procedures based in part on these risks and gather audit evidence that is adequate and suitable to form a basis for our opinions. The risk of not discovering a material misstatement due to impropriety is higher than for a material misstatement due to error because improprieties can include acting in collusion, falsifying, intentional omission, incorrect information or disregarding internal controls.
- we obtain an understanding of the part of the company's internal control that is of significance to our audit to carry out auditing procedures that are suitable considering the circumstances, but not to make a statement on the effectiveness of internal controls.
- we evaluate the suitability of the accounting principles used and the reasonability of the Board's and CEO's estimates in the accounting and associated disclosures.
- we draw a conclusion on the suitability of the Board and CEO using the going concern assumption in preparing the annual accounts and consolidated accounts. We also draw a conclusion based on the audit evidence collected whether or not there are any material uncertainty factors pertaining to such events or conditions that may lead to significant doubt about the company's and the Group's ability to continue business. If we draw the conclusion that there is a material uncertainty factor, we must in our audit report call attention to the disclosures in the annual accounts and consolidated accounts regarding the material uncertainty factor or, if such disclosures are inadequate, modify the opinion regarding the annual accounts and consolidated accounts. Our conclusions are based on the audit evidence gathered up to the date of the audit report. However, future events or circumstances may mean that the company and Group can no longer continue operations.
- we evaluate the overall presentation, structure and content of the annual accounts and consolidated accounts, including the disclosures, and if the annual accounts and consolidated accounts portray the underlying transactions and events in a manner that provides a true and fair view.
- we gather adequate and suitable audit evidence regarding the financial information for the units or business activities within the Group to express an opinion concerning the consolidated accounts. We are responsible for the management, supervision and implementation of the Group audit. We are solely responsible for our opinions.

We must inform the Board of the audit's planned scope and emphasis as well as it's timing. We must also inform about significant observations during the audit, including the significant deficiencies in the internal control we identified.

STATEMENT ON OTHER LEGAL AND REGULATORY REQUIREMENTS

Opinions

In addition to our audit of the annual accounts and consolidated accounts, we also conducted an audit of the Board's and the CEO's administration for IVL Svenska Miljöinstitutet AB for the 2016 financial year and of the proposed appropriation of the company's profit or loss.

We recommend to the General Meeting that the profit be dealt with in accordance with the proposal in the administration report and that the members of the Board of Directors and the CEO be discharged from personal liability for the financial year.

Grounds for opinions

We conducted our audit in accordance with generally accepted auditing standards in Sweden. Our responsibility according to these standards is described in more detail in the section on "Auditor's responsibility". We are independent in relation to the Parent Company and Group in accordance with generally accepted auditing standards in Sweden and have otherwise fulfilled our professional ethics responsibility according to these requirements.

We believe that the accounting evidence we have obtained provides an adequate and appropriate basis for our opinions.

RESPONSIBILITIES OF THE BOARD OF DIRECTORS AND THE CEO

The Board of Directors has the responsibility for the proposal on the appropriation of the company's profit or loss. In the event of a proposed dividend, this includes an assessment of whether the dividend is justifiable considering the requirements set by the company's and Group's nature of operations, scope and risks on the size of the Parent Company's and the Group's equity, consolidation requirements, liquidity and position otherwise.

The Board is responsible for the company's organisation and the management of its affairs. This includes continuously assessing the company's and Group's financial situation, and ensuring that the company's organisation is structured so that accounting, asset management and the company's financial affairs otherwise are controlled in a satisfactory manner. The CEO shall take care of the operating management according to the Board's guidelines and instructions and take the actions necessary for the company's bookkeeping to be performed in accordance with law and for asset management to be managed in a satisfactory manner.

Auditor's responsibility

Our objective regarding the audit of the management, and thereby our statement regarding discharge from liability, is to collect audit evidence to be able to assess with a reasonable degree of certainty if any Board member or the CEO to any material respect:

- took any action or committed any negligence that may lead to a liability to pay damages to the company, or
- in any way acted counter to the Swedish Companies Act, the Annual Accounts Act or the Articles of Association.

Our objective regarding the audit of the proposed appropriation of the company's profit or loss, and thereby our statement regarding this, is to assess with a reasonable degree of certainty if the proposal is consistent with the Swedish Companies Act.

Reasonable certainty is a high degree of certainty, but no guarantee that an audit done in accordance with generally accepted auditing standards in Sweden will always discover actions or negligence that can lead to liability to pay damages to the company, or that a proposed appropriation of the company's profit or loss is not consistent with the Swedish Companies Act.

As a part of an audit according to generally accepted auditing standards in Sweden, we use professional judgement and have a professionally sceptical approach in the entire audit. The review of the administration and the proposed appropriation of the company's profit or loss is primarily based on the audit of the accounts. What additional review procedures are done is based on our professional assessment on the basis of risk and materiality. This means that we focus the review on such measures, areas and circumstances that are significant to the business and where deviations or violations would be of particular significance to the company's situation. We go through and test decisions made, decision documentation, actions taken and other circumstances that are relevant to our opinion regarding discharged from liability. As a basis for our opinion on the Board of Director's pro- posed treatment of the company's profit or loss, we have examined whether such arrangements are consistent with the Swedish Annual Accounts Act.

Stockholm, 29 March 2017

Tomas Nöjd,
Authorised Public Accountant

Christina Kallin Sharpe
Authorised Public Accountant

CORPORATE GOVERNANCE

Corporate Governance at IVL Swedish Environmental Research Institute (Publ.) is based on Swedish legislation and generally accepted practices, with due account taken of the Swedish Code of Corporate Governance. The reason why the Swedish Code of Corporate Governance is not observed in every respect is that it is mainly designed for listed companies and companies with diversified ownership.

OWNERSHIP

IVL has been wholly owned by the Swedish Institute of Water and Air Conservation Research Foundation (SIVL) since 2004. At conversion of the then Swedish Institute of Water and Air Conservation Research Foundation into a public limited company form in 1982, SIVL's original share capital was allocated in equal part by an agreement between, the Swedish government and the Swedish business sector.

SIVL's purpose is to develop the long-term conditions for environmental research and, through ownership, to guarantee IVL an independent status. SIVL is responsible for the funds provided for environment- and sustainability-related research at IVL co-funded by the Swedish government and the Swedish business sector.

BOARD OF DIRECTORS

SIVL is governed by a representative Board of Directors, of whom the Chair and six members are appointed by the Swedish government and seven members by the Swedish business community. The Chair has the deciding vote.

ANNUAL GENERAL MEETING

The Annual General Meeting (AGM) is generally held at the end of May. Members are notified of the AGM by post. The owner, SIVL, is represented at the AGM by SIVL's Chair.

At the 2016 AGM, held in late May, two new Board members were elected.

NOMINATION PROCEDURE

SIVL, the sole owner of IVL, proposes members for IVL's Board of Directors, partly by inviting nominations from business sector representatives for four regular members and one deputy member for IVL's Board of Directors, and partly by inviting nominations from the government for the Chair and three regular members and one deputy for IVL's Board of Directors.

IVL's Board of Directors shall consist of no less than four and no more than eight members, plus no less than one and no more than two deputies. In addition, the trade union representatives are entitled to nominate two members and two deputies.

The members of IVL's Board include five women and five men and they are presented on pages 82-83.

THE BOARD OF DIRECTORS AND ITS WORK IN 2016

Under the Swedish Companies Act and the company's Articles of Association, the Board of Directors is responsible for the organisation and administration of the company. Every year, the Board adopts rules of procedure. This document is accompanied by instructions for the work of the CEO, governing the allocation of tasks between Board and CEO.

In accordance with the rules of procedure, the Board held four ordinary meetings in 2016 in addition to the statutory meeting held in May in connection with the AGM. As is customary, the ordinary Board meetings were held in conjunction with reporting of the company's full-year or interim results, i.e. in March, May, September and December.

At all ordinary Board meetings, an agenda is followed that always includes a report from the CEO, financial reports, strategic issues and a risk and impact analysis.

At the Board meeting in March, the Directors' Report and the proposed appropriation of profit were approved and a refined market analysis was addressed. Items on the agenda for the Board meeting in May included adoption of new rules of procedure for the Board and instructions for work by the CEO. Special information was also provided regarding the company's risks, an impact analysis and measures or procedures for risk control. At the Board meeting in December, the agenda included the company's budget for 2017, as well as goals and strategy documents. At an extended meeting in September, the Board discussed the company's long-term strategy.

Remuneration Committee

Under the rules of procedure for the Board of Directors for IVL Swedish Environmental Research Institute (Publ.), the Board is to appoint a Remuneration Committee to deal with issues relating to terms and conditions of employment and remuneration. The Committee proposes salary, other forms of remuneration and other terms and conditions of employment for the CEO, which are then presented to the Board of Directors for approval. Similarly, terms and conditions for other members of executive management of the Company are proposed by the CEO, which are then presented to the Remuneration Committee for approval. The company does not operate any incentive programme.

Remuneration of the Board
At the 2015 AGM, fees were approved for the Chair and members of the Board. The fees approved were SEK 94 thousand (94) for the Chair and a total of SEK 491 thousand (515) for the other members of the Board. No fee is payable to the employee representatives.

EXTERNAL AUDIT

The auditors' task is, on behalf of the owner, to conduct an impartial review of the administration by the Board of Directors and the CEO, as well as of the company's annual report and accounting records.

R3 Revisionsbyrå KB, represented by Tomas Nöjd and Christina Kallin as senior auditors, has been elected as auditor to serve during the period until the 2017 AGM. Tomas Nöjd and Christina Kallin are authorised public accountants and have conducted the auditing assignment on behalf of IVL since 2014.

COMPANY MANAGEMENT

The CEO is responsible for the day-to-day administration of the Company in accordance with the guidelines and other instructions issued by the Board. The instructions for the work of the CEO were adopted on 26 May 2016 at the Board's statutory meeting.

The company's executive management group consists of the CEO, Executive Vice President, CFO, Vice President Business Development and Director of Research. The Company's management group also includes, four unit managers, the Director of Human Resources and Director of Communication. The Director of Quality and Environmental Issues is co-opted member.

- Tord Svedberg, born 1958, M. Sc. in Chemistry, KTH (1983) has served as Chief Executive Officer at IVL since 2008. He formerly served in a range of executive roles at Pharmacia (1984-1990), Astra (1990-1999) and AstraZeneca (1990-2007), including as head of production at the company in Sweden and member of executive management. Member of the Royal Swedish Academy of Sciences, Department IV.
- Östen Ekengren, born 1952, M. Sc. in Chemistry, KTH (1978), serves as Executive Vice President. Employed since 1978.
- Anna Jarnehammar, born 1965, M. Sc. Mechanical Engineering, 1991, Luleå University of Technology, Director of Business Development and Marketing. Employed by the company since 2005, first as a unit manager and then in 2014 as Director of Business Development. Anna Jarnehammar is chairman of IVL subsidiary Bastaonline AB.
- John Munthe, born 1960, Ph. D. in Chemistry at the University of Gothenburg (1992), Head of Research since 2010. He joined the company in 1992 and was appointed Head of Department in 1994.
- Mats Ridner, born 1955, MBA, Stockholm School of Economics, has served as CFO since 1994.

The unit heads, CFO, head of research and the Director of Quality and Environmental Issues report to the CEO.

Management is supported by executive staff functions for financial management, HR, communication, business development and quality and environmental management systems.

INTERNAL CONTROL

Internal control at the company is based on IVL's operational and management system. At the same time, this represents the company's integrated quality and environmental management systems, which are certified in accordance with ISO 9001 and ISO 14001. The management system focuses on IVL's core operations, that is to say, "to offer/market and conduct research and consultancy projects in the environmental field", and includes governing documents, procedures and tools for all processes within the company.

The internal control regarding financial reporting is comprised of the control environment with organisation, decision pathways, authority and responsibilities that have been documented and communicated in governing documents. All governing documents, procedures and tools are available via the company's intranet.

Every year, the Board adopts rules of procedure that govern the division of responsibilities between Board and CEO, and the company's financial reporting to the Board. Financial reports are presented to the Board at every meeting. These comprise outcomes, budget and comparison with the preceding year, as well as order backlog, investments and a number of key ratios.

EVALUATION OF THE BOARD AND THE CEO

The performance of the Board is evaluated annually. In 2016, this evaluation was carried out via a survey, conducted by the Swedish Academy of Board Directors, and presented at the December meeting.

The Board continually evaluates the CEO's performance by monitoring progress against objectives. Once a year, in conjunction with the March board meeting, a more formal evaluation is discussed with the Chief Executive.

RISK ANALYSIS AND MANAGEMENT

The management system also includes procedures and methodology for annual risk analysis of everything from economic risks and conditions, IT security, external factors and customer relations to loss of skills/expertise and image- and brand-related risks. The risk analyses are accompanied by action plans. The management system is subject to internal audit twice a year, as well as ongoing checks by independent quality and environmental auditors. This work is also presented to the Board.

BOARD OF DIRECTORS

Tord Svedberg, Karin Byman, Peter Nygårds, Gunilla Saltin, Linda Åmand, Johan Kuylenstierna, Maria Ohlman, Bo Olsson, Annika Helker Lundström, Anders Björk, Pär Larshans, Pernilla Bengtsson and Christer Forsgren.

ANNIKA HELKER LUNDSTRÖM
Chair
Member since 2010
National Environmental Goal Coordinator

PERNILLA BENGTSSON
Employee Representative
Member since 2014

ANDERS BJÖRK
Member since 2014
Employee Representative

CHRISTER FORSGREN
Member since 2008
Director, Stena Metall

KARIN BYMAN
Member since 2016
Energy Expert, IVA

JOHAN KUYLENSTIERNA
Member since 2014
CEO, Stockholm Environmental Institute

PETER NYGÅRDS
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SCIENTIFIC ARTICLES AND BOOK CHAPTERS

SUSTAINABLE URBAN DEVELOPMENT AND TRANSPORTS

Langer, A., Fredricsson, M., Weschler, C. J., Bekö, G., Strandberg, B., Remberger, M., Toftum, J. & Clausen, G. *Organophosphate esters in dust samples collected from Danish homes and daycare centers.* Chemosphere, 154, 559-566

Sandvall A., Ahlgren E. & Ekvall, T. *System profitability of excess heat utilisation: A case-based modelling analysis.* Energy 97:424-434

Proskurina, S., Rimppi, H., Heinimö, J., Hansson, J., Orlov, A., KC, R. & Vakkilainen, E. *Logistical, economic, environmental and regulatory conditions for future wood pellet transportation by sea to Europe: The case of Northwest Russian seaports.* Renewable and Sustainable Energy Reviews 56 p. 38-50

Norbäck, D., Hashim, J.H., Cai, G.H., Hashim, Z., Ali, F., Bloom, E. & Larsson, L. *Rhinitis, ocular, throat and dermal symptoms, headache and tiredness among students in schools from Johor Bahru, Malaysia: Associations with fungal DNA and mycotoxins in classroom dust.* PLOS One. In press

Winnes, H., Styhre, L. & Fridell, E. *Reducing GHG emissions from ships in port areas.* Research in Transportation Business & Management 17 (2015) 73–82

Black, J. & Styhre, L. *Environmental conflicts in port cities: A case study of Port Jackson and Port Botany in metropolitan Sydney* Proceedings of the WCTRs SIG2 2015 Conference, Antwerp, Belgium, 11-12 May 2015

Roso, V., Styhre, L., Woxenius, J., Bergqvist, R. & Lumsden, K. *Short Sea Shuttle Concept in Northern Europe. In European Intermodal Sustainable Transport – Quo Vadis?* MarIus nr. 459, pages 249-270. Sjorettsfondet, 2015, ISSN: 0332-7868

Buhr, K., Federley, M. & Karlsson, A. *Urban Living Labs for sustainability in suburbs in need of modernization and social uplift.* Technology Innovation Management Review, 6(1): 27-34

Langer S., Ramalho O., Derbez M., Ribéron J., Kirchner S., Mandin C. *Indoor environmental quality in French homes and its dependence on building characteristics.* Atmospheric Environment, 128, 82-91

Fridell, E. & Salo, K. *Measurements of abatement of particles and exhaust gases in a marine gas scrubber; proceedings of the Institution of Mechanical Engineers.* Journal of Engineering for the Maritime Environment, 230, 154

Magnusson, M., Fridell, E. & Härelind, H. *Improved low-temperature activity for marine selective catalytic reduction systems; proceedings of the Institution of Mechanical Engineers.* Journal of Engineering for the Maritime Environment, 230, 126

SUSTAINABLE PRODUCTION & ENVIRONMENTAL TECHNOLOGY

Woldemariam, D., Kullab, A., Fortkamp, U., Magnér, J., Royen, H. & Martin, A. *Membrane distillation pilot plant trials with pharmaceutical residues and energy demand analysis.* Chemical Engineering Journal, 306, 471-483

Schmidt, L., Gunnarsson, K., Dellve, L. & Antonsson, A-B. *Utilizing occupational health services in small-scale enterprises: A 10-year perspective.* Small Enterprise Re

Lazarevic, D. & Martin, M. *Life cycle assessments, carbon footprints and carbon visions: Analysing environmental systems analyses of transportation biofuels in Sweden.* Journal of Cleaner Production, 137, 249-257.

Arnell, M., Astals, S., Åmand, L., Batstone, D.J., Jensen, P.D. & Jeppsson, U, *Modelling anaerobic co-digestion in Benchmark Simulation Model No. 2: Parameter estimation, substrate characterisation and plant-wide integration.* Water Research 98, pp 138-146

Stripple, H. *Evaluation of two different drainage systems for rock tunnels.* Tunnelling and Underground Space Technology vol. 58 (2016) 40–48

Arvidsson, R., Hildenbrand, J., Baumann, H., Islam, K., & Parsmo, R. *A method for human health impact assessment in social LCA: Lessons from three case studies.* The International Journal of Life Cycle Assessment, 1-10

Malmaeus, M., Ek, M., Åmand, L., Roth, S., Baresel, C. & Olshammar, M. *Efficiency of an emissions payment system for nitrogen in sewage treatment plants - A case study.* Journal of Environmental Management, 154, 346-350

Hagberg, M., Pettersson, K. & Ahlgren, E.O. *Bioenergy futures in Sweden – Modeling integration scenarios for biofuel production.* Energy 109, 1026-1039

Peñaloza, D., Erlandsson, M. & Falk, A. *Exploring the climate impact effects of increased use of bio-based materials in buildings.* Construction and Building Materials 125 (2016) 219–226

Baresel, C., Dahlgren, L., Almemark, M., & Lazic, A. *Municipal wastewater reclamation for non-potable reuse. Environmental assessments based on pilot-plant studies and system modelling.* Water Science & Technology, 72(9), 1635-1643

NATURAL RESOURCES, CLIMATE & ENVIRONMENT

Ceola, S., Montanari, A., Krueger, T., Dyer, F., Kreibich, H., Westerberg, I., Carr, G., Cudennec, C., Elshorbagy, A., Savenije, H., Van Der Zaag, P., Rosbjerg, D., Aksoy, H., Viola, F., Petrucci, G., MacLeod, K., Croke, B., Ganora, D., Hermans, L., Polo, M. L., Xu, Z., Borga, M., Helmschrot, J., Toth, E., Ranzi, R., Castellarin, A., Hurford, A., Brilly, M., Viglione, A., Blöschl, G., Sivapalan, M., Domeneghetti, A., Marinelli, A. & Di *Baldassarre, G. Adaptation of water resources systems to changing society and environment: : a statement by the International Association of Hydrological Sciences.* Hydrological Sciences Journal, 61:16, 2803-2817, DOI: 10.1080/02626667.2016.1230674

Jutfelt, F., Sundin, J., Raby, G. R., Krång, A-S. & Clark, T. D. *Two-current choice flumes for testing avoidance and preference in aquatic animals.* Methods in Ecology and Evolution. doi: 10.1111/2041-210X.12668

Liagkouridis, I., Cequier, E., Lazarov, B., Palm Cousins, A., Thomsen, C., Stranger, M. & Cousins, *I. T. Relationships between estimated flame retardant emissions and levels in indoor air and house dust.* Indoor Air, 1-8

Giovanoulis, G., Alves, A., Papadopoulou, E., Palm Cousins, A., Schütze, A., Koch, H. M., Haug, L. S., Covaci, A., Magnér, J. & Voorspoels, S. *Evaluation of exposure to phthalate esters and DINCH in urine and nails from a Norwegian study population.* Environmental Research, 151, 80-90

Christodoulakis, J., Tzanis, C.G., Varotsos, C.A., Ferm, M. & Tidblad, J. *Impacts of air pollution and climate on materials in Athens.* Greece. Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-196, 2016.

Hansson, J. & Hackl, R. *The potential influence of sustainability criteria on the European Union pellets market – the example of Sweden.* WIREs Energy and Environment, 5(4) p. 413-429.

Hansen, K., & Malmaeus, M. *Ecosystem services in Swedish forests.* Scandinavian Journal of Forest Research 31(6), 626-640. DOI:10.1080/02827581.2016.1164888.

Westerberg, I. K., Wagener, T., Coxon, G., McMillan, H. K., Castellarin, A., Montanari, A. & Freer, J. *Uncertainty in hydrological signatures in gauged and ungauged catchments.* Water Resources Research, 52, 1847–1865, doi:10.1002/2015WR017635.

Anttila, P., Brorström-Lundén, E., Hansson, K., Hakol,a H. & Vestenius, M. *Assessment of the spatial and temporal distribution of persistent organic pollutants (POPs) in the Nordic atmosphere.* Atmospheric Environment 140 (2016) 22e33

Holmgren, K. M., Berntsson, T., Andersson, E. & Rydberg, T. *Comparison of integration options for gasification-based biofuel production systems - economic and greenhouse gas emission implications.* Energy, 111, 272-294, http://dx.doi.org/10.1016/j.energy.2016.05.059

Decocq, G., Andrieu, E., Brunet, J., Chabrerie, O., De Frenne, P., De Smedt, P., Deconchat, M., Diekmann, M., Ehrmann, S., Giffard, B., Mifsud, E. G., Hansen, K., Hermy, M., Kolb, A., Lenoir, J., Liira, J., Moldan, F., Prokofieva, I., Rosenqvist, L., Varela, E., Valdés, A., Verheyen, K. & Wulf, M. *Ecosystem services from small forest fragments in agricultural landscapes.* Current Forestry Reports 2(1), 30-44. DOI 10.1007/s40725-016-0028-x

Löfgren, S., Ågren, A., Gustafsson, J P., Olsson, B. A. & Zetterberg, T. *Impact of whole-tree harvest on soil and stream water acidity in southern Sweden based on HD-MINTEQ simulations and pH-sensitivity.* Forest Ecology and Management, doi:10.1016/j.foreco.2016.07.018

Zetterberg, T. *Measured and modelled long-term effect of whole-tree harvest. Impact on soil and surface water acid-base status in boreal forests.* Diss. Uppsala: SLU Swedish University of Agricultural Sciences

Zetterberg, T., Olsson, B.A., Löfgren, S., Hyvönen, R. & Brandtberg, P-O. *Long-term soil calcium depletion after conventional and whole-tree harvest* Forest Ecology and Management, 369: 102-115.

Schröder, W., Nickel, S., Schönrock, S., Meyer, M., Wosniok, W., Harmens, H., Frontasyeva, M.V., Alber, R., Aleksiayenak, J., Barandovski, L., Carballeira, A., Danielsson, H., Temmermann, L., Godzik, B., Jeran, Z., Pihl Karlsson, G., Lazo, P., Leblond, S., Lindroos, A-J., Liiv, S., Magnússon, S., Mankovska, B., Martínez-Abaigar, J., Piispanen, J., Poikolainen, J., Popescu, I.V., Qarri, F., Santamaria, J.M., Skudnik, M., Špirić, Z., Stafilov, T., Steinnes, E., Stihi, C., Thöni, L., Uggerud, H.T. & Zechmeister, H.G. *Spatially valid data of atmospheric deposition of heavy metals and nitrogen derived by moss surveys for pollution risk assessments of ecosystems.* Environ Sci pollut Res. DOI 10.1007/s11356-016-6577-5

Huber, S., Warner, N. A., Nygård, T., Remberger, M., Harju, M., Uggerud, H. t.T, Kaj, L. & Hanssen, L. *A broad cocktail of environmental pollutants found in eggs of three seabird species from remote colonies in Norway.* Environ Toxicol Chem., 34:6, 1296-1308

Huber, S., Remberger, M., Kaj, L., Schlabach, M., Jörundsdóttir, H. Ó., Vester, J., Arnórsson, M., Mortensen, I., Schwartson, R. & Dam, M. *A first screening and risk assessment of pharmaceuticals and additives in personal care products in waste water, sludge, recipient water and sediment from Faroe Islands, Iceland and Greenland.* Science of the Total Environment 562 (2016) 13–25

Camino-Serrano, M., Graf Pannatier, E., Vicca, S., Luyssaert, S., Jonard, M., Ciais, P., Guenet, B., Gielen, B., Peñuelas, J., Sardans, J., Waldner, P., Etzold, S., Cecchini, G., Clarke, N., Galić, Z., Gandois, L., Hansen, K., Johnson, J., Klinck, U., Lachmanová, Z., Lindroos, A. J., Meesenburg, H., Nieminen, T. M., Sanders, T. G. M., Sawicka, K., Seidling, W., Thimonier, A., Vanguelova, E., Verstraeten, A., Vesterdal, L., & Janssens, I. A. *Trends in soil solution dissolved organic carbon (DOC) concentrations across European forests.* Biogeosciences, 13, 5567–5585. doi:10.5194/bg-13-5567-2016

Hallquist; M., Munthe, J., Hu, M, Wang, T., Chan, C., Gao J., Boman, J., Guo, S., Hallquist, Å. M., Mellqvist, J., Moldanova, J., Pathak, R. K., Pettersson, J. B. C., Pleijel, H., Simpson, D. & Thynell, M. *Photochemical Smog in China: Scientific challenges and implications for air quality policies.* National Science Review 2016;doi: 10.1093/nsr/nww080

Ekener, E., Hansson, J. & Gustavsson, M. *Addressing positive impacts in social LCA – discussing current and new approaches exemplified by the case of vehicle fuels.* The International Journal of Life Cycle Assessment, doi: 10.1007/s11367-016-1058-0

Holmgren, K.M., Berntsson, T.S., Andersson E. & Rydberg T. Perspectives on investment cost estimates for gasification-based biofuel production systems. Chemical Engineering Transactions, 45, 427-32, DOI: 10.3303/CET1545072

Stigson, P., Haikola, S., Hansson, A. & Buhr, K. *Prospects for Swedish acceptance of carbon dioxide storage in the Baltic Sea: Learning from other energy projects, Greenhouse Gases.* Science and Technology, 5:1–9

Oulehle, F., Cosby, B.J., Austnes, K., Evans, C.D., Hruška, J., Kopáček, J, Moldan, F. & Wright R.F. *Modelling inorganic nitrogen in runoff: Seasonal dynamics at four European catchments as simulated by the MAGIC model* Sci. Tot. Env. 536 (2015) 1019–1028.

Harmens, H., Norris, D.A., Sharps, K., Mills, G., Alber, R., Aleksiayenak, Y., Blum, O., Cucu-Man, S.-M., Dam, M., De Temmerman, L., Ene, A., Fernández, J.A., Martinez-Abaigar, J., Frontasyeva, M., Godzik, B., Jeran, Z., Lazo, P., Leblond, S., Liiv, S., Magnússon, S.H., Maňkovská, B., Pihl Karlsson, G., Piispanen, J., Poikolainen, J., Santamaria, J.M., Skudnik, M., Spiric, Z., Stafilov, T., Steinnes, E., Stihi, C., Suchara, I., Thöni, L., Todoran, R., Yurukova, L. & Zechmeister, H.G. *Heavy metal and nitrogen concentrations in mosses are declining across Europe whilst some "hotspots" remain in 2010.* Environmental Pollution 200, 93-104

Hackl, R., Hansson, J., Norén, F., Stenberg, O. & Olshammar, M. *Utilisation of Ciona Intestinalis for Biogas and Biofertilizer Production - Process Modelling, Carbon Footprinting and Sensitivity Analysis.* 6th International Symposium on Energy from Biomass and Waste, Venice, Italy.

Setälä, O., Magnusson, K., Lehtiniemi, M. & Norén, F. *Distribution and abundance of surface water microlitter in the Baltic Sea: A comparison of two sampling methods.* Marine Pollution Bulletin 110, 177-183

Sandvall, A., Börjesson, M., Ekvall, T. & Ahlgren, E. *Modelling environmental and energy system impacts of large-scale excess heat utilisation: A regional case study* Energy, 79, 68–79

Pleijel, H., Grundström, M., Pihl Karlsson, G., Karlsson, P-E. & Chen, D. A method to assess the inter-annual weather-dependent variability in air pollution concentration and deposition in south-west Sweden based on weather typing. Atmospheric Environment 126, 200-210.

Nerentorp Mastromonaco, M. G., Gårdfeldt, K., Langer, S. & Dommergue, A. *Seasonal study of mercury species in the Antarctic sea ice.* Environmental Science and Technology, 50(23), 12705–12712

Martin, M. & Danielsson, L. *Environmental Implications of Dynamic Policies on Food Consumption and Waste Handling in the European Union.* Sustainability, Volume 8, Issue 3

Hellsten, S., Stadmark, J., Pihl Karlsson, G., Karlsson, P. E. & Akselsson, C. *Increased concentrations of nitrate in forest soil water after windthrow in southern Sweden.* Forest Ecology and Management 356, 234-242

Pacyna, J. M., Travnikov, O., De Simone, F., Hedgecock, I. M., Sundseth, K., Pacyna, E. G., Steenhuisen, F., Pirrone, N., Munthe, J. & Kindbom, K. *Current and future levels of mercury atmospheric pollution on a global scale.* Atmos.Chem. Phys., 16, 12495-12511, doi:10.5194/acp-16-12495-2016

Angot H., Dastoor A., De Simone F., Gårdfeldt K., Gencarelli C.N., Hedgecock I.M., Langer S., Magand O., Mastromonaco M.N., Nordstrøm C., Pfaffhuber K.A., Pirrone N., Ryjkov A., Selin N.E., Skov H., Song S., Sprovieri F., Steffen A., Toyota K., Travnikov O., Yang X. & Dommergue, A. *Chemical cycling and deposition of atmospheric mercury in polar regions: Review of recent measurements and comparison with models.* Atmos. Chem. Phys., 16, 10735–10763

Sprovieri, F., Pirrone, N., Bencardino, M., D'Amore, F., Carbone, F., Cinnirella, S., Mannarino, V., Landis, M., Ebinghaus, R., Weigelt, A., Brunke, E-G., Labuschagne, C., Martin, L., Munthe, M., Wängberg, I., Artaxo, P., Morais, F., Barbosa, H. M. J., Brito, J., Cairns, W., Barbante, C., Diéguez, M. C. D., Garcia, P. E., Dommergue, A., Angot, H., Magand, O., Skov, H., Horvat, M., Kotnik, J., Read, K. A., Mendes Neves, L., Gawlik, B. M., Sena, F., Mashyanov, N., Obolkin, V., Wip, D., Feng, X., Zhang, H., Fu, X., Ramachandran, R., Cossa, D., Knoery, J., Marusczak, N., Nerentorp, M. & Norstrom, C. *Atmospheric mercury concentrations observed at ground-based monitoring sites globally distributed in the framework of the GMOS network.* Atmos. Chem. Phys., 16, 11915-11935, doi:10.5194/acp-16-11915-2016

Pleijel, H., Grundström, M., Pihl Karlsson, G., Karlsson, P.E. & Chen, D. *A method to assess the inter-annual weather-dependent variability in air pollution concentration and deposition in south-west Sweden based on weather typing.* Atmospheric Environment (2015), doi: 10.1016/j.atmosenv.2015.11.053.

Wängberg, I., Nerentorp Mastromonaco, M. G., Munthe, J. & Gårdfeldt, K. *Airborne mercury species at the Råö background monitoring site in Sweden: Distribution of mercury as an effect of long-range transport.* Atmos. Chem. Phys., 16, 13379-13387

Büker, P., Feng, Z., Uddling, J., Briolat, A., Alonso, R., Braun, S., Elvira, S., Gerosa, G., Karlsson, P. E., Le Thiec, D., Marzuoli, R., Mills, G., Oksanen, E., Wieser, G., Wilkinson, M. & Emberson, L. D. *New flux based dose-response relationships for ozone for European forest tree species.* Environmental Pollution 206, 163-174

RESOURCE-EFFICIENT RECYCLING & CONSUMPTION

Soimakallio, S., Cowie, A., Brandão, M., Finnveden, G., Erlandsson, M., Koponen, K. & Karlsson, P-E. *Attributional Life Cycle Assessment: Is a land-use baseline necessary?* International Journal of Life Cycle Assessment 20:1364–1375

Ekvall, T., Fråne, A., Hallgren, F. & Holmgren, K. *Material pinch analysis: A pilot study on global steel flows.* Metallurgical Research & Technology, 111, 359-367

Ahlgren, S., Björklund, A., Ekman, A., Karlsson, H., Berlin, J., Börjesson, P., Ekvall, T., Finnveden, G., Jansson, M. & Strid, I. *Based on a review of existing LCA standards and guidelines, this paper provides recommendations on how to handle six key methodological issues when performing LCA studies of biorefinery systems: (i) goal definition, (ii) functional unit, (iii) allocation of biorefinery outputs, (iv) allocation of biomass feedstock, (v) land use, and (vi) biogenic carbon and timing of emissions.* Biofuels, Bioproducts & Biorefining. 9(5), 606-619.

Levidow L., Lindgaard-Jørgensen P., Nilsson Å., Alongi Skenhall S. & Assimacopoulos, D. Process eco-innovation: Assessing meso-level eco-efficiency in industrial water-service systems. Journal of Process Control. Volym 110, 54-65

Leal Filho, W., Brandli, L., Kruopienė, J., Stenmarck, Å. & Moora, H. *Benchmarking approaches and methods in the field of urban waste management.* Journal of Cleaner Production, Volume 112, Part 5, 20 January 2016, Pages 4377–4386

Malmaeus, M. *Economic Values and Resource Use.* Sustainability 2016, 8, 490; doi:10.3390/su8050490

Arm, M., Wik, O., Engelsen, C., Erlandsson, M., Hjelmar, O. & Wahlström, M. *How does the European recovery target for construction & demolition waste affect resource management?* Waste Biomass Valor, Springer, DOI 10.1007/s12649-016-9661-7

de Rosa, M., Rydberg, T. & the SETAC Europe LCA Steering Committee SETAC LCA advisory groups silver jubilee: Get involved and contribute to the next stage of LCA, Int J LCA DOI 10.1007/s11367-016-1192-8

Ekvall, T., Hirschnitz-Garbers, M., Eboli, F. & Sniegocki, A. A systemic and systematic approach to the development of a policy mix for material resource efficiency. Sustainability 8(4): 373ff.

Ljunggren Söderman, M., Eriksson, O., Björklund, A., Östblom, G., Ekvall, T., Finnveden, G., Arushanyan, Y. & Sundqvist, J-O. *Integrated Economic and Environmental Assessment of Waste Policy Instruments.* Sustainability 8(5): 411ff.

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