2014 Sustainability report

Elkem
A Bluestar Company

Content

Cover photo is from Elkem Technology.
Read more about our research facilities on page 28.

Key figures

FINANCIALS	UNIT	2014		2013*		2012	
Revenues	NOK million	8 652		7 789		8 093	
EBITDA	NOK million	1 060		644		770	
EBIT	NOK million	611		418		(127)	
Profit for the year	NOK million	303		(628)		(457)	
Total assets	NOK million	11 025		11 668		11 607	
Net interest-bearing assets / (debt)	NOK million	2 279		145		(5 039)	
Equity	NOK million	8 757		7 697		4 305	
Equity ratio	Per cent	79		66		37	
Health and safety							
No. of employees		2 127		2 092		2096	
Sick leave rate	Per cent	3.4		3.7		3.9	
No. of lost time injuries per million work hours	H1	2.1		0.8		1.8	
Energy and emissions		**Norway**	**Group**	**Norway**	**Group**	**Norway**	**Group**
Energy recovered	GWh	438	628	370	450	158	340
CO_2 emissions	Thousand tonnes	746	1 463	831	1 335	870	1 300
NO_x emissions	Tonnes	5 764	6569	5 100	5602	5 125	8 500
SO_2 emissions	Tonnes	3 539	7267	3 200	7256	3 233	7 000

* Elkem Solar is presented as discontinued operation for the two months ended February 2014 and for the year ended 2013 and 2012. As a consequence Elkem Solar is not included in revenues, EBITDA, EBIT and net interest-bearing asset/(debt). Please refer to accounting principles under consolidated financial statement Elkem AS group for more details.

Carbon neutral metal production

Elkem is among the world's cleanest metal manufacturers but still emits around 1.3 million tonnes of CO_2 each year. We are now looking into how this may come to an end.
A research project in Elkem will lay the foundation for full-scale production without net CO_2 emissions and without a net supply of energy. Read more on page 29.

Si 2020 – improving our production process

The basic principles of silicon production are around 100 years old. A number of different improvement measures have resulted in a considerably better process. In 2011, Elkem decided to start a research programme that would carry out a thorough review of each step of the production process. We do this to examine the residual potential that remained regarding better material yield and reduced losses, lower emissions, and more efficient energy consumption. Read more on page 30.

Affirmative action in South-Africa

As part of the South African equal opportunities policy, which aims to rectify historic inequalities for disadvantaged ethnic groups, the government has implemented laws that govern how companies should contribute to redress these disparities. Each company has a scorecard that ranks their impact on what is called Broad Based Black Economic Empowerment (BBBEE). Read more about how Elkem works with this on page 47.

We are facing a green industrial revolution

The Intergovernmental Panel on Climate Change has stated that a two degree Celsius increase in the Earth's average temperature represents the limit of what nature can withstand before climate changes become uncontrollable. If the world is going to achieve this goal, emissions of greenhouse gases must be reduced by 95 per cent by 2050. For the industry this means that our greenhouse gas emissions must cease within the next 35 years.

In other words: 'business as usual' is no longer an option. Research is a top priority in Elkem because we know that it is the only way to ensure that there is a place for us in the future. Gradual improvements have always been important to Elkem. Elkem Business System, our most important management tool, is based on the idea of continuous improvement. However, if we are going to solve the world's sustainability challenges we also need technological leaps. Elkem is therefore working to establish new climate technology with global potential.

Two years ago we started a research project that aims to develop a process for carbon neutral metal production, which is also electricity neutral: the production plant will be capable of generating as much electricity as is consumed in the process. If we achieve this, it will represent a technological quantum leap that could change the whole industry around the world. The work is supported by the Research Council of Norway and the ambition is to be ready to start constructing a full-scale smelting plant within 5-7 years. This will be a green industrial revolution.

For high-risk climate project such as this it is vital for the progress that the public sector has joined us by ensuring that adequate funds are available, especially in the pilot/demonstration phase. Funding to promote new technology is one way in which Norway and other countries can contribute to cutting global emissions.

The Norwegian metallurgical industry is world-leading, and bases its success on research-driven innovation linked to the production of metals the world needs. From April 2015 the industry's innovation work will receive an important boost when the entire Norwegian metallurgical industry gathers behind 'SFI Metal Production'. SFI is the Norwegian abbreviation for the Centre for Research-based Innovation (Senter for Forskningsdrevet Innovasjon), a programme run by the Research Council of Norway.

The research centre will be funded through a joint effort between the industry, the Research Council of Norway and academia. This is good news, both for Norwegian industry and for the global metal industry.

Our goal is zero injuries. Elkem's workplaces should be safe. Unfortunately, the injury rate for 2014 was no lower than in 2013. We had 22 personal injuries in 2014, the same as in 2013. Even though these incidents were not very serious, it is unacceptable for our employees or subcontractors to be injured at our plants. This applies to both serious injuries and any health suffering that may occur due to prolonged exposure. We will therefore strengthen our focus on EHS in 2015. All employees must understand their personal responsibilities and how individuals can contribute to the improvement work. There will be a stronger focus on fire prevention, we will monitor all locations where water and molten metal may come into contact and may cause explosions, and we will complete our work on better electricity safety.

Our research projects are aimed at lower energy consumption and emissions, and our focus on EHS goes hand in hand to ensure our place in a sustainable future.

Elkem – an overview

Elkem is a world-leading producer of silicon, ferrosilicon-based speciality alloys, carbon products and microsilica. The 2014 turnover was NOK 8,652 million. Elkem had 2,127 employees in about 40 countries throughout the world in 2014. Elkem is part of China National Bluestar (Group) Co. Ltd.

Elkem Silicon Materials is one of the world's leading suppliers of silicon and microsilica. Silicon has a wide range of applications, such as an important additive in certain aluminium alloys and in the chemical industry, where silicon is the main ingredient in silicones. Silicon is also necessary for the production of solar cells and almost all electronic devices. Microsilica is extremely finely grained silicon that is used as additive in concrete, refractory materials, plastics, fertiliser and sealants for oil wells.

Elkem Foundry Products is the world's leading producer of ferrosilicon and ferrosilicon-based speciality alloys. Ferrosilicon is used as an additive to improve the properties of steel and iron that are used, for example, in the production of windmills, trains, cars and other mechanical devices. Elkem's speciality alloys are added during the customer's foundry operations and contribute to increased productivity and reduced energy consumption.

Elkem Carbon is the world's largest producer of electrically calcinated anthracite, which is used in electrode paste and sealants (ramming paste) that are necessary in the manufacturing process of steel, aluminium, silicon and other metals.

Elkem Solar produces solar-grade silicon for the solar industry, using a metallurgical process that requires only about 25 per cent of the energy consumption of traditional manufacturing processes. Elkem Solar is now 50 per cent owned by Elkem and 50 per cent by Guangyu International Investment Company.

Elkem Technology conducts research and development projects related to all parts of Elkem's value chain. The research strategy is based on close cooperation between the operational organisation and the researchers.

Elkem's plants and offices around the world: Plant Office

Corporate management

Back: **Asbjørn Søvik** SVP Elkem Carbon, **Kjell Ramsdal** SVP Corporate development, **Trond Sæterstad** SVP Elkem Silicon Materials, **Morten Viga** CFO, **Helge Aasen** CEO, **Mark Breidenthal** VP EHS & CSR.

Front: **Kristin Karlstad** VP Public Relations, **Liu He** SVP Elkem China, **Katja Lehland** SVP Human Resources, **Inge Grubben-Strømnes** SVP Business development and Solar, **Håvard Moe** SVP Elkem Technology, **Jean Villeneuve** SVP Elkem Foundry Products.

Board of directors

Robert Lu
CEO Bluestar
Chairman

Sverre T. Tysland
Selmer DA
Board member

Olivier de Clermont-Tonnerre
Bluestar Silicones
Board member

Helge Aasen
Elkem AS
Board member

Yougen Ge
Bluestar
Board member

Einar Støfringshaug
Union representative
Board member

Espen Sortevik
Union representative
Board member

Corporate governance

Elkem is part of the China National Bluestar (Group) Co. Ltd. (Bluestar). Bluestar is a global group in the chemical industry that focuses on new chemical materials and animal nutrition.

Elkem is governed by the board of directors, which consists of seven persons, five of whom are elected by the owners and two by the employees. Mr. Robert Lu, CEO of Bluestar, is chairman of Elkem's board. Elkem's CEO, Helge Aasen, sits on the board as a representative elected by the owners. Aasen also sits on Bluestar's board of directors.

Elkem's board meets at least four times a year and conducts its activities in accordance with approved rules of procedure that are based on the provisions of the Norwegian Limited Liability Companies Act. These rules regulate the board's responsibility and the CEO's relationship to the board. The main tasks of the board are to ensure the sound organisation of the company's activities, adopt plans and budgets, supervise the general management, and ensure that the company's activities, accounts and asset management are subject to proper scrutiny.

Elkem's work on corporate social responsibility is coordinated through a steering committee lead by the SVP HR. The steering committee reports directly to Elkem's CEO. In 2014, the steering committee initiated extensive updates in Elkem's guiding documents.

Non-hierarchical organisation

Elkem has had employee representatives on its board since 1974 and promoted the introduction of corporate democracy in Norway. The relationship between corporate management and employees is characterised by a flat organisational structure.

Detailed authority structure and internal control

A detailed authority structure has been developed to regulate who can make decisions at various levels in the organisation with the board being the highest ranking body for business-related decisions.

The group's internal control function is exercised through monthly reviews of the business activities at the group management level. The monthly reviews are conducted according to a stated agenda.

Updated risk assessment

Assessment of risk includes all aspects of the enterprise and are delegated as a line responsibility. This includes health and environmental risk, financial risk, market risk (price and volumes) and operational risk. There are policies and procedures for all risk areas, and the risk assessment is updated regularly. Measures are decided on and implemented as soon as possible. The board and management are regularly updated on the group's performance.

Sustainable growth

Elkem's vision is to develop advanced materials that shape the future. Our mission is to help promote a sustainable future by producing advanced silicon- and carbon-based solutions that create value for all our stakeholders. We believe that safe and sustainable operations are the future and that our products and innovations can help solve many of the world's challenges.

Our solutions shape the future

Our products are based on two of the world's most common elements – silicon and carbon. The products we manufacture from these elements are essential building blocks for current and future materials. As a manufacturer we think that safe and environmentally-friendly production is the only way forward. During our 110 year long history we have developed a very good understanding of the silicon process, which we are now using to consolidate our position as the world's most environmentally-friendly manufacturer of these products. Our research constantly facilitates safer and more efficient production. This gives a lower consumption of energy and lower emissions of greenhouse gases, reduces the losses in production and results in the utilisation of more and more by-products. Elkem is working to introduce energy management and energy recovery in all plants. In the long run our goal is to remove all waste through efficient utilisation of all by-products and side streams.

The demand for Elkem's products is expected to increase in the coming years. We see that cooperation with our customers, suppliers and other partners helps develop solutions that give our customers better quality, higher efficiency and reduced emissions. Our technology and processing knowledge will continue to form the basis for many of the solutions that are needed in order to shape a sustainable future for our planet, such as highly efficient solar cells and windmills, batteries that may abate fluctuations in the production of renewable energy, as well as smart electronics.

Our values

Our core values are the foundation for the way we work in Elkem. The work of each individual, regardless of where they are in the value chain, is based on the following values: **involvement, respect, precision and continuous improvement.**

Involvement commits people. Despite smart systems and artificial intelligence, it is still people who are best at identifying problems and finding solutions. Through the wide involvement of our colleagues, customers and other stakeholders, we create openness and teamwork that increase our ability to learn and to develop new solutions.

Respect entails being open and honest, trusting colleagues, appreciating diversity and promoting fairness. We respect the law, the environment, our employees, colleagues, customers, suppliers, owners, the society, the local community, and other cultures.

Our focus on precision is evident in our efforts to develop and comply with standards for best practices and stable, safe operations. By establishing standards for work practices and working conditions we can measure and thereby continuously improve them.

We know that the value chain can always be improved by experimenting, by making use of new solutions, and by continuously eliminating waste. Continuous improvement means that we are always looking for potential improvements and that we are open to learn new things and willing to share knowledge.

Management systems for responsible conduct

Elkem's internal control system oversees the conditions in the workplace that can affect employees' health and safety or negatively affect the environment, and are kept within the rule of law, rules and licenses, and Elkem's policy.

Elkem's risk management instructions emphasise all types of risks that can affect the business. The purpose of the instructions is to ensure a systematic approach to risk management within Elkem. Risk management shall ensure that risks that are significant to Elkem's goals are surveyed, analysed and handled at as early a stage as possible and in a systematic and cost-efficient manner. It is Elkem's experience that investment in proactive risk-reducing measures carries significantly lower costs than acting retroactively.

'Focus' is Elkem's programme for environment, health and safety in the workplace. Elkem has a goal of zero injuries and occupational illnesses, and works systematically to achieve this goal. Reports are prepared for each business area every month. The reports include an overview of high risk incidents and near-accidents as well as lessons to prevent similar incidents to occur in the future.

Elkem's ethical guidelines apply to all Elkem employees. The guidelines address each employee's responsibility for ensuring that Elkem maintains a high EHS standard, for ensuring that discrimination and harassment do not occur, for the prohibition on corruption, the management of confidential information, compliance with competition rules and for accuracy in public reporting. A basic principle is that all employees shall comply with and respect the law wherever they are.

Elkem has a **whistleblowing procedure** that employees can use to note their concerns about possible breaches of Elkem's ethical guidelines or other possible unethical or illegal actions.

Elkem does not contribute to political parties.

Elkem's guidelines for social responsibility describes areas of responsibility within the organisation and routines for ensuring compliance with Elkem's **'Principles for social responsibility'**. The principles address our responsibility for safeguarding basic human rights, the employees' rights as workers, environmental concerns, a sustainable exploitation of natural resources and business integrity.

Elkem's supplier requirements impose requirements on suppliers regarding human rights and responsible environmental management. Elkem's standard procurement contracts refer to Elkem's principles for social responsibility as a requirement for signing contracts. Elkem provides training and implements supplier audits, and continuously work with the goal of ensuring compliance throughout the value chain.

Working together

Working together with local communities, regulatory authorities, organisations, politicans, researchers and other interested parties outside the company forms an important part of Elkem's activities.

Local communities

Many of Elkem's plants are cornerstone companies that are very important to the development of local communities. Maintaining a good dialogue with neighbours and local politicians is therefore important. Elkem is a long-term partner in local communities. It is occasionally necessary at some plants to organise public meetings to inform people about potential hazards from operations and the measures that are being taken to protect both the company and the local community from adverse impacts. One example of this is Elkem Solar in Kristiansand. The company is subject to the Norwegian Major Accident Regulation and is therefore obliged to hold regular information meetings for local residents.

Research centres

Elkem works extensively with many research centres around the world. Elkem's researchers are based in Kristiansand and at the Norwegian University of Science and Technology (NTNU) in Trondheim. They work closely with institutions such as SINTEF, NTNU, the Institute for Energy Technology (IFE), and Teknova/University of Agder, and carry out industry projects through the Norwegian Ferroalloy Producers Research Association and the Eyde-network. Our international research partners include institutions such as the Wuhan University of Science and Technology (China), L'Ecole des Mines d'Alès (France), Fraunhofer Institute and Technische Universität Bergakademie Freiburg (Germany), Texas A&M University System (USA), Okayama University (Japan), KTH (Sweden) and the University of Central Lancashire (UK).

Business policy

Elkem's centre of gravity is in Norway and the company wants to contribute to, and influence, the general conditions for Norwegian industry. This involves communicating what various policies require and implicate when they are put into practice at plant level. Elkem is a member of the Federation of Norwegian Industries. The EU is also an important actor when it comes to determining the policy framework for industry. Elkem is therefore active in European industry organisations such as Euroalliages and Eurometaux.

Directorates and supervisory authorities

Elkem's activities are regulated by a number of laws, regulations and requirements in the countries in which we operate. This entails maintaining an extensive dialogue with, and reporting to, various supervisory bodies such as directorates and supervisory authorities. Elkem wants to be a constructive partner. We comply with applicable local regulations. At the same time, we are an active partner that wants to comment on what new instructions will entail when they are implemented, and suggest changes.

Funding systems

Support for R&D projects, especially in Norway and the EU, is important when Elkem implements major, expensive R&D projects on energy efficiency, reducing emissions and other improvements. Enova, the Research Council of Norway, Innovation Norway, Siva, the business sector's NOx Fund, the Environmental Fund, and private actors such as the Competence Development Fund of Southern Norway, are important partners in Norway. Elkem also receives funding under the Horizon 2020 programme in the EU.

The employees of the future

Elkem wants to encurage young people to choose science subjects and educations that are relevant to the industry. In addition to recruiting apprentices and trainees, Elkem uses school visits, workweek placements, trade fairs and other forums to meet pupils and students near our production locations around the world. Employees in Elkem also teach in upper secondary schools and universities via teacher programmes and adjunct professorships in Norway.

Organisations

Elkem maintains extensive dialogue with numerous environmental organisations in order to share knowledge about various environmental topics associated with the operation of Elkem's plants and to support the professional and political work of these organisations.

Tools for continuous improvement

Elkem Business System (EBS) is a set of fundamental principles, methods and tools that describes how employees at all levels should conduct themselves and how the organisation should work together to achieve common goals and continuous improvement. EBS forms the foundation of Elkem's corporate culture and operations.

Individual responsibility

One of the main EBS principles is that people are the driving force. Therefore, each Elkem employee is encouraged and expected to actively find and suggest potential improvements to the processes he or she is involved in. In order to ensure that everyone can take part in and contribute to improvements, all of Elkem's plants have established arenas for active daily improvement efforts.

Management responsibility

Another key principle of EBS is that managers must have in-depth knowledge about critical processes. Therefore, Elkem's managers are present in the organisation and regularly visit production facilities to see for themselves what is happening, talk with employees about production flow and any other issues, and encourage and discuss suggested improvements. Giving direct, specific feedback on how each employee is performing his/her duties is an important management task in Elkem. Job observation and cooperation, team organisation and annual appraisal interviews provide a basis for the professional and personal development of Elkem's employees.

The four main principles of Elkem Business System are:

1. Make to use

The customer's needs are always in focus. This is also the case internally in Elkem, where everyone in the organisation is regarded as interlinked suppliers and customers in a value chain. Value added is a key component, both in relations with our customers and suppliers and in our own organisation.

2. Empowered people

Elkem ascribes 70 per cent of its success to human input and 30 per cent to the underlying system and technical equipment. Those who perform the tasks are the experts, and together they constitute Elkem's resource base. We attempt to live up to our core values in all of our activities, including collaboration with suppliers.

3. Eliminating waste

Eliminating all forms of waste lies at the heart of Elkem's goal of continuous improvement.

4. Processes in control

All processes shall be stable and predictable, and variations shall be avoided.

Continuous development

Elkem's managers, together with Human Resources (HR), are responsible for ensuring that Elkem's employees have the skills the company needs and that the Elkem Business System (EBS) is actively practised at all levels of the organisation. Along with technology and process know-how, improvement skills, i.e. EBS, are the core skills in Elkem.

Elkem employees

At year-end 2014, Elkem had 2,127 employees. Around half of these were working as operators at Elkem's production plants in Norway, Canada, Brazil, China and Iceland. Elkem has sales offices in a number of countries and approximately 200 of its employees were working in sales at year-end 2014. Elkem's total R&D staff at group and divisional level number around 160 employees. Elkem's head office is in Oslo, which is also the base for central administrative functions.

Apprentices and trainees

Elkem actively uses the Norwegian apprenticeship scheme and Elkem's global trainee scheme to ensure the group's companies have a skilled workforce in the future. A total of 48 apprentices are currently training at Elkem's plants. 10 of these are young women. We have a total of six trainees: four women and two men.

Skills development

Elkem operates in a demanding market in which there is a great need for continuous development. The improvement work needs to be fast paced and of good quality. This means that employees' skills need to be developed constantly. Elkem believes that the best way to develop people is for them to participate in improvement work and problem solving in their day-to-day work. Elkem also offers a number of in-house training activities and courses to strengthen the company's core skills. Willingness to take on new duties and responsibilities is also very important for an individual's learning and development.

Management development

Capable managers are a necessity for an organisation that wants to obtain good results. Elkem therefore further expanded its global management development portfolio in 2014 and now carries out management development on multiple levels and with a greater geographic breadth than before. The management development programmes are intended to provide Elkem's managers with training in the practical challenges managers face, as well as a professional top-up and an opportunity to build internal networks. This enables managers to learn from each other and aids the transfer of skills across divisions and plants in the global company.

Elkem Business System (EBS)

Elkem's EBS centre is a resource centre and provides support to Elkem's divisions and plants when it comes to implementing EBS. All business areas also have dedicated personell with both in-depth knowledge about EBS and the division's operations who has responsibility for ensuring that EBS is implemented in the division. HR at the plant is, together with the local management, responsible for developing the plant in line with EBS principles.

Equal opportunities

The process industry is generally male dominated. However, Elkem has noticed that with more automation and less heavy manual work, women are increasingly expressing an interest in working in the process industry. The percentage of female employees has increased slightly in recent years, but remains low. Elkem wants to achieve a better gender balance among its employees and is striving to ensure that the proportion of female trainees is at least 50 per cent. The total proportion of women in Elkem is 21 per cent.

Mutual respect

Elkem is an international company with Chinese owners and production and sales offices in many countries. Having a global presence and employees with diverse backgrounds are obvious strengths for the company. Proximity to the markets and good teamwork across geographic, cultural and individual differences are necessary for the company to achieve its goals. EBS is based on every employee playing an important role. Elkem's employees are specialists in their fields and should be listened to. This ensures both good operations and the best solutions when challenges arise. Elkem's internal recruitment rules and its code of conduct for employees prohibit all forms of discrimination.

Corporate democracy

Elkem has been through many major reorganisations in its more than 110-year history. The international market Elkem operates in is highly competitive and exposed to market fluctuations, and the need for restructuring is a constant challenge. Good teamwork between employees and managers is a prerequisite if Elkem is to cope with what are at times demanding market conditions, and has a long tradition of employees and managers working well together. All plants and other units in Norway have unions representing both operators and administrative personell. Outside Norway, Elkem complies with local statutory requirements and values good teamwork with, and the extensive involvement of, employees. In Norway, five formal committees have been created for contact between the company and employee representatives. Pursuant to the provisions of the Companies Act employees have two representatives and two observers on the board of Elkem AS.

Zero tolerance for injuries and strains

Elkem's health and safety work is based on a philosophy where we will not accept injuries or illnesses being caused by our working environment, and will do everything in our power to prevent them.

In the last few years the number of injuries per year and the seriousness of the injuries have stabilised at a relatively low level for the vast majority of units in Elkem. However, injuries still occur and prevention work will be further intensified in 2015.

Elkem experienced 22 injuries requiring medical treatment amongst our employees in 2014, the same number of injuries as in 2013. Three of Elkem's 18 plants accounted for half of these injuries, while seven of the plants experienced no injuries at all. Typical injuries are sprains and small cuts or crush injuries to hands. The most serious injuries were a number of instances where parts of fingertips were amputated.

Our experience from the last few years shows that many plants manage to achieve zero or only one injury year after year. This means that it is possible to achieve a target of zero. Unfortunately, experience also shows that achieving zero injuries one year is no guarantee that injuries will not occur the following year. To ensure that the EHS work is successful it is crucial that there is high awareness of safety throughout the organisation at all times.

The injury prevention principles are based on knowing the potential hazards, understanding the likelihood of potential hazards occurring and their consequences, and effective work to eliminate or reduce potential hazards to an acceptable level. Much of the prevention work also focuses on behaviour, since statistics show that the vast majority of injuries are caused by the actions of individuals.

'Focus'

'Focus' is Elkem's programme for environment, health and safety (EHS) in the workplace. 'Focus' is closely linked to the Elkem Business System (EBS), and the emphasis is on continuous improvement and each employee's responsibility to contribute to good results. 'Focus' has five fundamental principles:

1. Improvements have no limits.
2. All incidents and injuries can be prevented (zero philosophy).
3. All injuries and high risk incidents have causes. The causes are always linked to dangerous situations, dangerous actions, or a combination of these. Reporting and investigating all incidents and injuries allows us to find the causes and eliminate them before they lead to more serious harm.
4. Effective prevention requires risk identification, risk analysis, and the implementation of measures in order to reduce unacceptable risk to an acceptable level.
5. Success depends on all employees being actively involved in the EHS work and sharing the responsibility for ensuring a safe working environment.

Assessed by the management

The status of the EHS work is discussed every week at division and group management level. Serious incidents and personal injuries are presented and discussed so that the lessons learned can help lower the injury rates further.

Reporting and investigating all adverse

incidents form an important part of Elkem's improvement work. Reports are produced by business areas every month. The focus is on serious incidents and injuries, as well as reporting for official statistics. Detailed presentations of the course of events that led up to an incident, including root causes and lessons learned, are produced for all serious incidents. This enables the lessons learned to be shared with other plants and similar incidents to be avoided at other locations in the future.

Modifying hazardous equipment

One example of good prevention work was the elimination of potential hazards as part of the rebuilding of a lathe for machining finished baked electrodes at Elkem Carboindustrial in Brazil. The project stressed machine safety by correctly protecting movable parts and safely using lifting equipment by remotely controlling the crane hook so that operators did not have to stand as close to the material during lifting operations. A series of other improvements were also achieved in the following areas:

- Noise level
- Dust level
- Wearing work position
- Potential falls
- Energy insulation during cleaning and maintenance
- Better order and cleaning

Testing protective equipment

It is not always possible to eliminate exposure to hazardous situations completely through technical measures on systems and equipment. In such circumstances personal protective equipment must be worn. One example of this is exposure to dust, which in some work operations is at a level that necessitates the use of protective masks.

However, personal protective equipment may give a false sense of security if one does not ensure that the equipment fits and that the user is well trained in the use and maintenance of the equipment. Elkem is currently running a long-term project focusing on respiratory protective equipment where employees who have to use protective masks can test the airtightness of their masks during use with advanced measuring equipment. People are different and it is therefore necessary to find out whether the mask allocated is being used correctly, that it actually fits, and that it is airtight.

Elkem also has a dedicated product committee tasked with purchasing and testing new personal protective equipment to ensure the best protection in all work situations.

Topic of the month

Elkem's central EHS staff circulate a special presentation on an important topic almost every month. The first topic of the year is normally a review of injuries and lessons learned from the year before. Before the summer holidays they always review how the EHS standards and EHS

work in the relevant workplace is best introduced and followed up for summer temps and new employees.

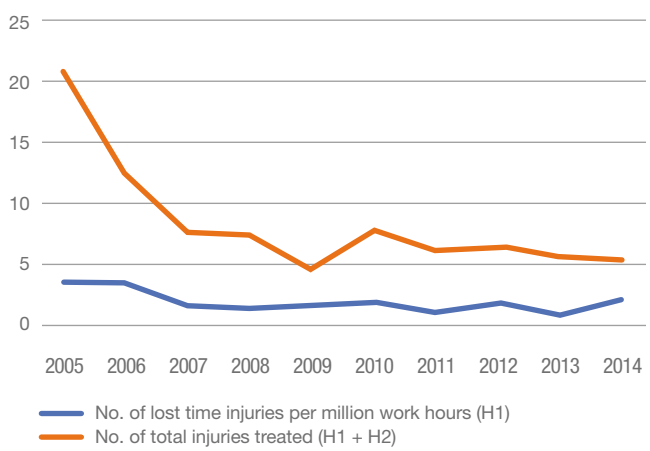
The topics in 2014 were:

- Lessons learned from 2013
- Noise
- Energy insulation
- 5S (order, cleaning)
- Temporary staff
- Hand and finger injuries
- Dust explosions
- Behaviour
- Falls on same or lower level

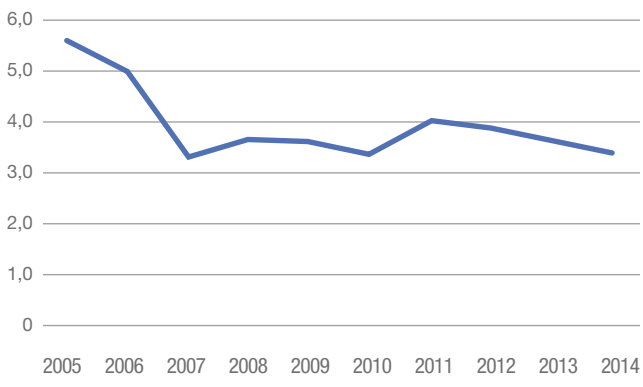
Sick leave

The average sick leave rate for Elkem's employees was 3.4 per cent in 2014, compared with 3.7 per cent in 2013. Ongoing activities to reduce sick leave include closely following up each employee during periods of absence and implementing adaptations to facilitate graduated sick leave.

TREND IN NUMBER OF INJURIES per million work hours



SICK LEAVE IN PER CENT



EHS audits for continuous improvement

Elkem's own specialists carry out environment, health and safety (EHS) audits of all plants at two-year intervals. The goal is that all plants shall have the same high standard, in line with both Elkem's own requirements and the statutory requirements, regardless of where they are located in the world.

An EHS audit of a plant is well planned and lasts for up to three days, depending on the plant's size and complexity. The primary focus is safety, but health and the external environment are also touched upon. The management at a plant that is audited must assess its own systems and performance before the visit. The plant gives itself a score of one to ten, where ten is the best, for a list of factors.

Improvement and learning

The participants in the group that conducts an audit can vary, but as a rule they include Elkem's EHS director, the EHS manager in the relevant division, and one or two EHS managers from other plants. This ensures both the participation of best possible EHS expertise and the dissemination of best practice. Audits are not just about checking standards, they are also important tools for improvement and learning. Audits help to ensure that plants stay up-to-date on the development of requirements and best practice and that they actively work on improving their systems and prevention activities.

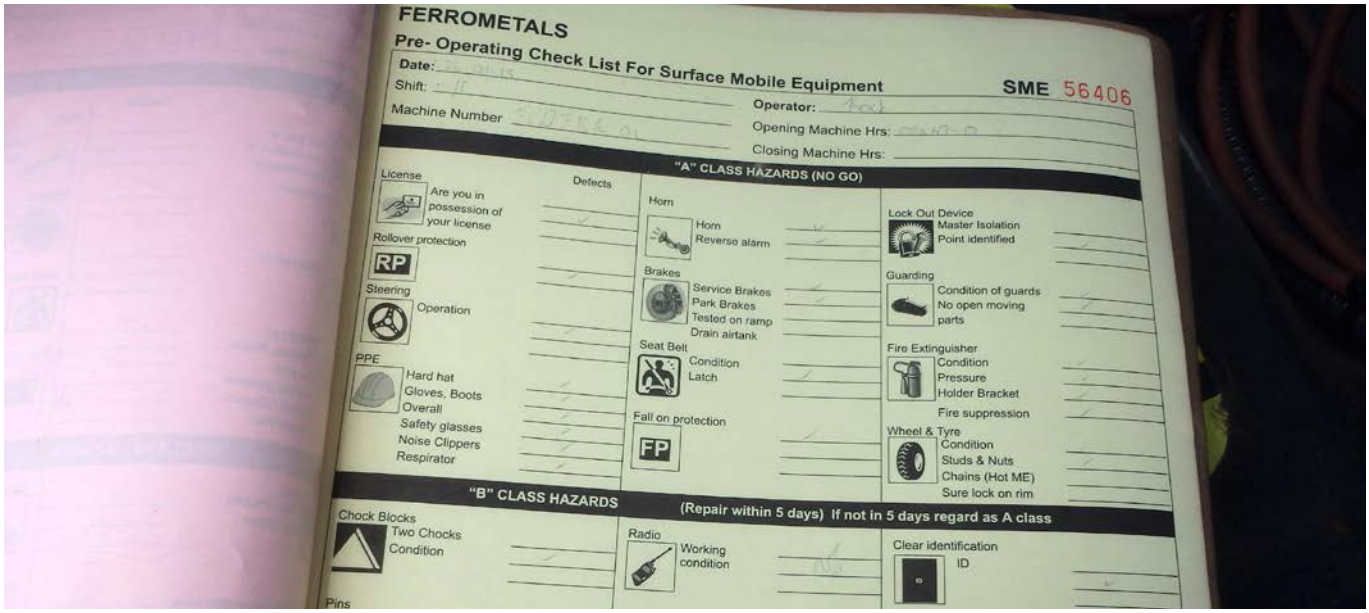
No guarantee

A good score one year is no guarantee for achieving the same good result in the next audit, two years later. In addition to control and discussions about check points and the company's EHS system, plenty of time is set aside for inspections, observing work situations, and discussions on improvements in operations with operators in each work area and managers in charge. The purpose is to answer questions, share best practice, and agree on clear standards.

The audit report includes a report where factors associated with the check points are described with text and photos. The photos make it possible to communicate the message and standards to all employees, regardless of linguistic skills. They also make it easier to see the progress made from one audit to the next.

Checklist for Elkem's EHS audits

1 5S, housekeeping & storage
2 Fall control
3 Mobile equipment
4 Confined space entry
5 Energy isolation – lockout tag-out try
6 Molten metal
7 Dust control
8 Machine safety
9 Hot work and gas
10 Electrical safety
11 Cranes, tackle and lifting equipment
12 Emergency preparedness
13 Projects and contractor work
14 Fire prevention
15 Personal protective equipment
16 Chemicals and fibers
17 Environmental issues
18 Buildings and structures

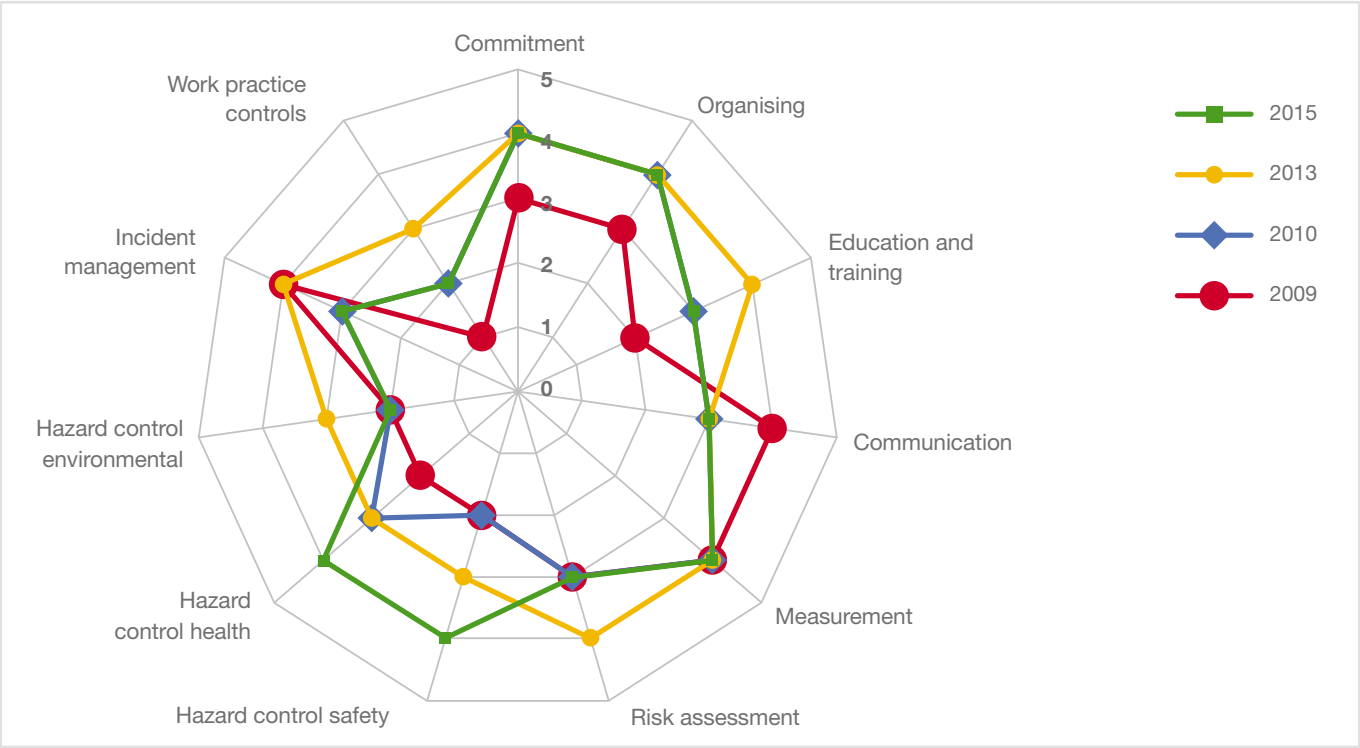


EXAMPLE OF A AUDIT REPORT

Focus area:				Comments / pictures:
Vehicle standard				Generally good standard, but forklifts are not in compliance with corporate standard (open)
Vehicle condition and cleaning				Generally good, but some defects on mirrors and seatbelts observed. Boundaries should be put around whole vehicle when defective.
Vehicle signals / lights				
Pre-use checklist				Good improvement from last audit
Vehicle / pedestrian segregation				Good improvements in many areas
Traffic plans / signs and signals				Speed limits and right of way not posted
Loading / unloading				Good control with behavior during loading
Securing of load				Load securing on finished products is not done on many trucks – must check legal requirements
Observed driving behaviour				Behaviour varied between drives from very good to OK – seatbelts observed not in use 2 times

Some deviances observed – OK | Overall good, but some key observations | Deviations observed - need for more focused work

EHS-SYSTEM ASSESSMENT FOR ONE OF ELKEMS PLANTS 2009 - 2015



Energy efficiency and scrubbing measures in Elkem

Problem	Measures	Where	Solution provides
Unused thermal energy from production Poor resource utilisation Unnecessary (indirect*) CO_2 emissions	Energy recovery plant for sale of hot water, steam or electricity	All plants	Hot water and steam for reuse or sale Electricity for sale Better resource utilisation Lower (direct*) CO_2 emissions
Unnecessary electricity consumption for furnace operation Poor resource and raw material utilisation	Ensuring stable furnace operation and continuous development of optimum furnace operation	All plants	Lower electricity consumption Better resource and raw material utilisation
Unnecessary electricity consumption for plant operations, other than furnaces Poor resource utilisation and higher costs	Energy efficiency measures	All plants	Lower electricity consumption Better resource utilisation and lower costs
Inadequate control of silicon dust from production Local pollution and loss of sellable by-product	Collection of dust in scrubbing system connected to silicon and ferrosilicon furnaces Processes under control	All silicon and ferrosilicon plants	Valuable by-product – microsilica Less pollution and better quality of life in local environment Better reputation for the industry
Inadequate control of dust in the workplace Deterioration of the working environment Wasting sellable by-product More cleaning and maintenance	Development of production methods for avoiding dust generation Better extraction and cleaning	All plants	Improved working environment and EHS results Reduced time/costs for cleaning and maintenance Sellable by-product
NO_x emissions Poorer air quality in the local environment	Introduction of new feed method, new furnace design in line with research results	Elkem Silicon Materials' plants in Norway	Up to 40 per cent lower NO_x emissions
SO_2 emissions Poorer air quality in the local environment, odour	Use of raw materials with less sulphur where appropriate. SO_2 capture and scrubbing	Raw material use in all plants Plans for SO_2 capture at Elkem Carbon Fiskaa	Eliminates SO_2 emissions Better reputation for the industry
Runoff to the sea and ground of pollutants	Better control of diffuse emissions Bio-purification of polluted rain water at plants in tropical climates	Elkem Carbon Fiskaa Elkem Carbon, Brazil	Reduced supply of polluted dust into the surroundings that can be dispersed further by water Clean water

* All of Elkem's energy recovery facilities are installed in areas where the electricity is generated by hydroelectric power. Therefore, CO_2 emissions are only reduced indirectly as the electricity that is no longer consumed by Elkem's plants can be exported to areas where it can replace, for example, gas or coal power.

A circular economy for the climate and environment

Elkem's sustainability philosophy is based on the general principle of producing as efficiently as possible and with the maximum reuse of all side streams, i.e. materials and energy.

Elkem's goal of zero waste means that the company attaches great importance to the recovery and use of side streaming of all kinds. A circular economy, where production and consumption are part of a cycle, is necessary if the world's population is to live well within the earth's resources. One example of this is described in the article 'Zero waste to landfill' from Iceland on page 42.

Elkem's goal is to ensure that all the plants are equipped with suitable energy recovery systems. Around 200 GWh was recovered in 2014 in the form of electricity and 400 GWh in the form of steam and hot water. Examples of this are described in the articles from Canada and Bjølvefossen on pages 42 and 43.

In 2013, Elkem's plants in Norway and Iceland became subject to the EU's system for trading CO_2 quotas. Energy recovery measures at the plants and the high consumption of charcoal over many years result in lower net emissions of fossil CO_2 and thus less need to purchase quotas.

242,000 quotas

Elkem's silicon and ferrosilicon plants are based on hydroelectric power, which means there are zero CO_2 emissions from electricity consumption. The CO_2 emissions largely stem from the actual production processes. You can read why silicon production results in CO_2 emissions on page 24.

In 2014 Elkem purchased 241,740 CO_2 quotas to cover its CO_2 emissions from the plants in Norway and Iceland, all of which are covered by the EU's emission trading system (ETS). This accounts for about 22 per cent of Elkem's allocated quotas. Companies like Elkem are awarded 75 per cent of their needs based on historical product data, but are credited with quotas for heat sales, energy recovery or using biocarbon for chemical reduction.

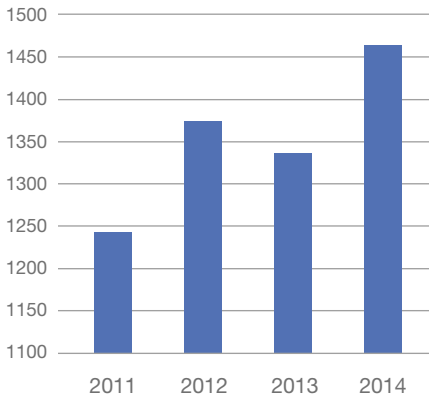
Regional quota schemes can present a problem for companies that operate in a global market. For this reason the EU's and Norway's schemes to compensate for the indirect effects quota trading has on energy prices in Norway are very important. Even though the ETS price is currently low, it nonetheless entails a mark-up in energy prices that has a significant effect on companies that consume a lot of power, such as Elkem. Elkem received compensation of NOK 31 million[1] in 2014 for the impact that prices for CO_2 had on energy prices. This compensation scheme is important to counter 'carbon leakage', i.e. companies in the European Economic Area (EEA) relocating outside the EEA and thus moving their emissions to another region. Both the awarding of free quotas and the compensation for the impact of the prices for CO_2 on energy prices are temporary schemes that will be gradually tightened, meaning that Elkem's allocations via these schemes will shrink each year, while costs will vary according to CO_2 prices as before.

New technology

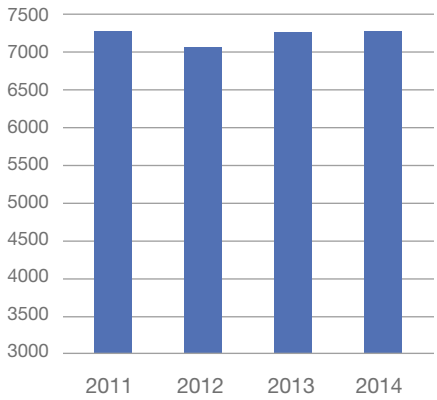
Absolute emissions of CO_2, NO_X, and SO_2 (sulphur) will in the short-term first and foremost vary with production levels, because it takes a long time to change production technology. This also applies in those areas where technological breakthroughs have been made in the form of scrubbing and changed production processes, because phasing in new technology is often expensive and complicated. Elkem expects a significant drop in NO_X and SO_2 as new technology becomes available. As far as net CO_2 emissions are concerned, it will gradually become possible to utilise more biological materials in the reduction process as replacements for fossil coal. You can read more about this on pages 20, 24 and 29.

The work on reducing dust emissions has produced good results in recent years. You can read about Elkem's work on reducing dust emissions from silicon production on page 21.

CO_2 EMISSIONS[2] thousand tonnes



SO_2 (sulphur) EMISSIONS tonnes



1) Elkem appealed the decision and this was upheld by the Ministry of Climate and Environment in March 2015. However, the final amount of compensation has yet to be finally determined.
2) The increase of CO_2 emissions from 2013 to 2014 is a result of full utilisation of production capacity in 2014.

New investments result in lower NO_X emissions

Furnace 2 at Elkem Salten was upgraded in the spring of 2013. The rebuild reduced the furnace's NO_X emissions by 40 per cent. This successful project will be continued with the rebuilding of the plant's Furnace 3. Elkem's solution to NO_X emissions provides opportunities for significant environmental benefits in the smelting plant industry worldwide.

20 years of research and development lie behind Elkem's investments in furnace operations with significantly reduced NO_X emissions. Elkem's technological team in Trondheim has, in collaboration with SINTEF/NTNU, developed a thorough understanding of the formation of NO_X at the top of furnaces. Much of the credit for the results goes to an interdisciplinary team of representatives from Elkem plants and Elkem Technology. It is the fruit of patient efforts over many years that are now being put into operation. Elkem is sharing the results of its research so that other silicon smelting plants around the world can benefit from them. The goal is that this knowledge will help to ensure that metals are produced in a greener way all over the world. The research and development work was supported by the Research Council of Norway.

Better than expected

The newly developed technology was tested when Furnace 2 was rebuilt in the spring of 2013. A new hood design, i.e. the design of the top of the furnace, and the rebuilding of the oven for continuous supply of raw materials are the most important modifications. The effects of the rebuild were modelled at SINTEF/NTNU based on the results from pilot tests and computer simulations. There was a great deal of excitement surrounding the start-up of the new furnace in 2013. The result, a 40 per cent reduction in NOx emissions, was better than expected.

Furnace 3 - the next project

The rebuilding of Furnace 3 at Salten has been approved as the next NO_X reducing project. The goal is to reduce the furnace's NO_X emissions by 40 per cent, i.e. 425 tonnes per year. The rebuild is also expected to increase the yield of raw materials and produce further environmental benefits beyond the NO_X reduction. One of the main challenges is that the modifications will be made while the plant is operational. Elkem's philosophy of zero EHS injuries serves as a guideline and one of the project's main goals is for it to be completed without any EHS injuries.

Elkem Salten received support for rebuilding Furnace 2 from the NO_X Fund. The NO_X Fund will also support the rebuilding of Furnace 3. The support from the fund was the catalyst that ensured the completion of project. Salten Furnace 1 and the furnaces at Elkem's smelting plants in Bremanger and Bjølvefossen are on the list of future projects.

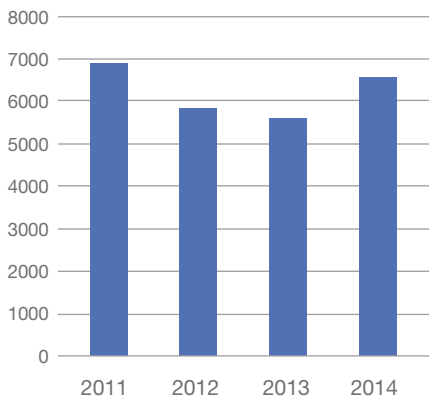
How is NO_X formed?

Silicon is the most common element in the earth's crust. It is extracted from the mineral quartz. In its natural state, silicon is 'married' to oxygen. This is a marriage that only a very high temperature can dissolve. Temperatures must reach 1,500-2,000 degrees Celsius before silicon will release the oxygen it is bound to the quartz; only then does the substance become a useful product.

Much of the released oxygen remarries with the carbon in coal, coke or wood in the furnaces and turns into CO_2. But some lonely oxygen atoms seeking a partner will always manage to bind themselves to nitrogen in the air instead and thus become nitrogen oxides (NO_X).

- Nitrogen oxides (NO_X) are gases that lead to higher concentrations of tropospheric ozone and acid precipitation. These emissions can be harmful to ecosystems and vegetation, as well as health.
- In Norway, the transport sector accounts for 58 per cent of the collective emissions, while industry accounts for 11 per cent.
- Elkem accounts for about 3 per cent of Norway's total NO_X emissions.
- The business sector's NO_X Fund is a team effort in which affiliated companies can apply for support for emissions reducing measures. The processing industry does not pay into the fund, but can still receive support for cost-effective measures.

NO_X EMISSIONS tonnes*



The increase of NOX emissions from 2013 to 2014 is a result of increased production in 2014.

* Elkem's emissions globally

Fight against dust shows results

Capturing dust generated during tapping and casting molten metal is especially difficult. The fight against dust is a top priority in Elkem, and is fought on many fronts. The results for 2014 show that these efforts have produced good results.

Dust is a health hazard and a pollutant. Dust also means waste because dust particles are products that have gone astray. Dust ruins equipment, creates a need for intensive cleaning, and prevents choosing the optimum equipment. Elkem allocates significant resources to combat dust for many reasons. However, extremely high temperatures and ultrafine particles that disperse very quickly make it especially difficult to capture the dust generated during tapping and casting molten metal.

Research and development

The FUME research project identified tapping and casting as primary sources of dust in the production of (ferro-)silicon. The project focused on understanding the problem and new solutions for dust collection near sources with gas temperatures of up to 1,400 degrees Celsius. A new four-year research project was initiated in 2015. This is intended to produce knowledge about how nanoparticle-sized, ultrafine dust is generated, how it affects health, and how employees can be protected from it. The project has been named 'Demaskus' and is a partnership between, amongst others, SINTEF, NTNU and St. Olavs Hospital. Fund supporters include the Research Council of Norway and the Norwegian Ferroalloy Producers Research Association.

In parallel with this research, Elkem has been developing new types of local exhaust ventilation for the tapping area, which is one of the most difficult emission points for combating dust. This comprehensive work has involved both mathematical modelling and empirical data. Broad participation from across the Elkem organisation has been vital to the results.

Installed on several furnaces

An industrial pilot for local exhaust ventilation for the tapping area ('doghouse') was installed on Thamshavn Furnace 1 in 2013. A similar system will be installed on Bremanger Furnace 4 in 2015, and a planning study linked to installing similar local exhaust ventilation on Salten Furnace 1 has been completed. The technology is relevant for all of Elkem's smelting plants, but many concept studies and technical calculations remain to be carried out before the solution is tailored to the different furnaces, each of which has its own peculiarities with respect to processing and structural conditions. Installing local exhaust ventilation technology also involves major investments. The new technology will be introduced in line with furnace upgrades in the coming years.

Action plans

Not all dust fighting measures involve investments that cost millions. Based on dust measurements that indicate the locations with the greatest dust exposure, all of Elkem's smelting plants have adopted anti-dust action plans that include a series of minor and major measures. One example of an individual measure is changing the cleaning methods employed. Vacuum cleaning instead of sweeping or blowing away dust has produced great results. Changing work position in relation to dust sources can also significantly reduce an individual's exposure.

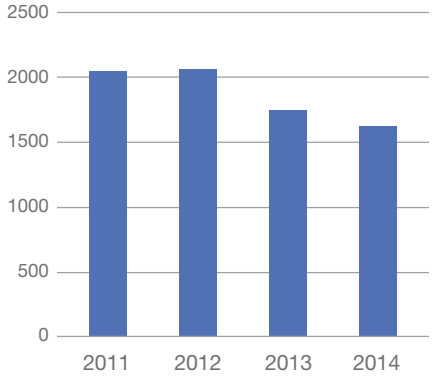
Good results

Major investments and continuously improved routines have produced both better working environments and lower diffuse emissions, i.e. emissions from a plant from sources other than chimneys. Elkem improved the measuring methods throughout 2014 to ensure that all instances of diffuse emissions are caught. The results have improved considerably, even with record high production and more extensive measuring.

External interest

Dust is a problem for smelting plants all over the world and Elkem's development work and practical experience of implementing new technology is of interest to many. For example, Ragnhild Jensen from Elkem was a keynote speaker at a large conference in 2014 in Johannesburg, South Africa. This brought together representatives from the African smelting industry. Elkem also publishes its dust research results.

DUST EMISSIONS tonnes*



* Elkem international numbers

Energy leadership

Silicon alloy production is very energy intensive. Elkem's production plants consume around 5 TWh of electrical energy every year, and around 7 TWh is consumed in the carbonaceous reduction materials used in the process. Elkem has introduced measures that have resulted in the recovery of around 600 GWh every year.

By introducing energy management into all plants, Elkem is in the process of analysing the total potential for increasing energy efficiency and investing in new solutions that will contribute to major improvements.

Energy efficiency

The most effective method of reducing the energy lost per produced tonne of silicon is to make the production process more energy efficient. Although Elkem has some of the most energy efficient smelting furnaces in the world, we continue to work systematically on improvements via a dedicated research and development project called Si 2020, which focuses on smelting furnace design, process control, and using raw materials more efficiently. Read more about Si 2020 on page 30.

Energy recovery

From the smelting process, two main pathways result in energy recovery. Both have their advantages and challenges.

The first method is based on letting surplus heat be used directly in the form of steam or hot water. Using steam and hot water is very efficient, but since most of Elkem's plants are located in sparsely populated areas there is little demand for heat from local communities or other industry.

The second method for energy recovery is based on using surplus heat to produce electricity. In this case one first has to convert it to high pressure steam/high temperature steam and then feed it into a turbine and generator that generates electricity. The advantage is that the electricity can be fed into the power grid. The problem is that two thirds of the energy is lost.

Both methods are currently in use in Elkem. Elkem Thamshavn generates around 160 GWh of electricity every year. Elkem Bjølvefossen generates 50 GWh of electricity every year and is now making investments to increase this to 80–85 GWh. Elkem's plant in Chicoutimi, Canada, currently has the capacity to supply up to 220 GWh of steam each year to the Rio Tinto plant that is its nearest neighbour. This is a recovery rate of 70–85 per cent of the electrical energy supplied to Elkem Chicoutimi. In addition to this, all of the plants recover more than 200 GWh as external or internal district heating.

Maintaining an intense focus on energy efficiency has made Elkem Thamshavn and Elkem Chicoutimi the world's most energy efficient plants for silicon and ferrosilicon production, respectively. The potential in Elkem's other plants is also enormous and a large number of projects have been set in motion to realise this potential.

Energy management

Elkem is currently introducing energy management systems that comply with ISO 50001 at all of our plants. This process has showed that even small measures, such as better insulation, motor inspections, lighting management, sealing leaks in compressed air systems, and heating and cooling control, can produce substantial savings, even though each individual measure is relatively small in itself compared with the energy consumption of a smelting furnace. Potential energy savings of 10 per cent (not linked to furnaces) have been identified. For the Norwegian plants, this entails 30 GWh of saved energy per annum. This is equivalent to the electricity consumed by 2,000 Norwegian households.

Energy recovery:

Upgrading the energy recovery plant at Elkem Bjølvefossen with a new steam turbine plus a number of other improvements will increase production from waste heat from around 50 GWh a year to more than 80 GWh a year. The project is scheduled for completion in 2015.

The main study for a new energy recovery plant at Elkem Salten with the potential to recover 300 GWh a year has been carried out. A final decision is pending.

Energy management:

Almost all of the plants in Norway have identified and started projects, with or without support from Enova, aimed at saving energy and reducing specific uses of energy. Below are a few examples:

- Elkem Bremanger is implementing a programme that includes new frequency management and new filters that will save around 22 GWh a year.
- Elkem Bremanger and Elkem Thamshavn are implementing a number of projects for new casting technology and classification technology that will produce higher yields equivalent to 30 GWh of energy saved per year.
- Elkem Salten and Elkem Solar have commenced work on a number of investments in new electrical equipment that will save up to 10 GWh a year.

The CNMP project:

At the end of 2014 Elkem's Carbon Neutral Metal Production (CNMP) project received NOK 7 million from the Research Council of Norway to develop a concept that combines charcoal production with silicon and ferrosilicon production and energy recovery in both processes. Using 100 per cent charcoal will make it possible to raise energy recovery up to the same level as the need for electrical energy in Elkem's smelting furnaces. The increased use of charcoal will also reduce our CO_2 emissions from fossil sources by up to 95 per cent.

Charcoal in silicon production

Charcoal is regarded as CO_2 neutral. Using charcoal instead of fossil coal in the production of silicon and ferrosilicon could reduce Elkem's CO_2 emissions significantly. This is a key part of Elkem's sustainable production strategy.

Silicon is produced using quartzite rock. Silicon is formed in a chemical process under high temperatures in a smelting furnace filled with quartz and carbonaceous materials. The process in the furnace causes the oxygen in the quartz to bind with the carbon. Quartz that is free of oxygen is silicon. The carbon that binds with oxygen becomes CO_2. That is why producing silicon always produces CO_2.

Using charcoal

Today Elkem primarily uses fossil coal as the carbonaceous material in our silicon and ferrosilicon production. Fossil coal has many advantages: Elkem requires extremely large quantities of carbonaceous materials of many different qualities and the global fossil coal market can meet its needs. As well as being easy available, fossil coal is a financially attractive alternative. However, it is the main source of Elkem's current CO_2 emissions.

Elkem already uses some charcoal in the smelting process and has for many years researched the quality-related, technical and practical aspects of replacing fossil coal with charcoal. Charcoal has advantages as an ingredient in the smelting process, but also disadvantages, because it contains trace elements that diminish the quality of some of Elkem's products.

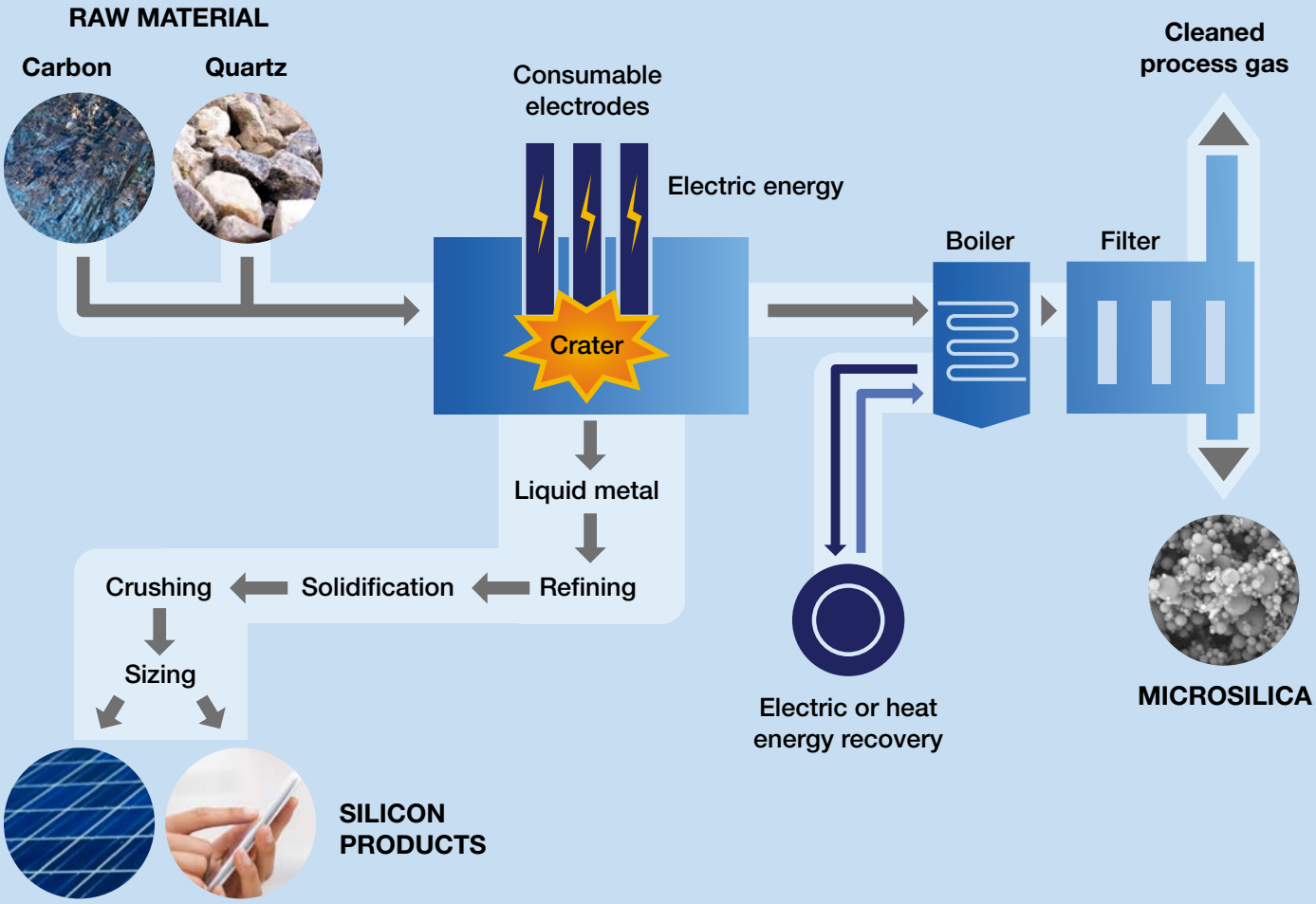
Dilemma

The main challenge today is that there is no functioning market that can supply the quantity of charcoal Elkem needs in its production process. Elkem has investigated the possibility of buying charcoal from production plants in equatorial countries where biomass grows rapidly that could provide a basis for industrial-scale charcoal production. Elkem requires charcoal of a defined quality in large quantities for its production, and buying a little from here and a little from there from small producers is not a practical alternative. Our experience from these projects shows that the risk of becoming directly or indirectly involved in deforestation, human rights violations, and corruption is very high.

Sustainable charcoal

Elkem has to establish very strict controls for charcoal suppliers to avoid becoming complicit in such violations. Elkem has adopted a specification of requirements for sustainable charcoal,

THE SILICON (AND FERROSILICON) PROCESS



which all suppliers must satisfy, as a basis for the further work on these issues. The requirements stipulate that the timber must come from a sustainable source, that the working conditions in the production process must be acceptable and comply with human rights, and that there will be zero tolerance of corruption and breaches of the law.

Norwegian timber

Charcoal produced using Norwegian timber as the raw material does not carry the same degree of risk with respect to sustainability, corruption, and human rights. The challenges here are availability, volume and price. Nor is there currently a production plant for charcoal in Norway and, given the current situation, estimates show that charcoal based on Norwegian timber would be many times more expensive than fossil coal. This would raise production costs and could result in Elkem's products being priced out of the market. Such a situation would be bad for the climate because most of Elkem's competitors in the global market use fossil coal in both their silicon production and their energy production.

Elkem wants to increase the proportion of charcoal in its production processes. We are actively seeking business opportunities that makes it possible to increase the use of charcoal that are ethically and financially sustainable.

A collaboration has been established with the industry, the Norwegian Ferroalloy Producers Research Association (FFF), and the Norwegian authorities to both analyse opportunities and find sustainable solutions.

Elkem is also working on technologies and research that in the future may make Norwegian timber attractive. The ultimate goal is for Elkem to become carbon neutral in the production of both silicon and ferrosilicon. Read about our CNMP project on page 29.

Monitoring plant water quality

Along with other industries located next to water, Elkem's six Norwegian plants were ordered in 2014 by the Norwegian Environment Agency to draw up a programme for monitoring water quality. The monitoring must be performed in 2015 in compliance with the requirements stipulated in the Water Regulations.

Earlier experience of water monitoring in Elkem

Elkem Carbon and Elkem Bremanger have already carried out water monitoring on their own initiative for many years due to regulated, legal emissions to sea. Elkem Bremanger started already back in the 1980s. Elkem Solar and Elkem Carbon, which are both located at Fiskaa in Kristiansand, have collaborated on a joint monitoring programme since 2010.

The Kristiansand fjord has long been one of Norway's chosen pilot fjords for water monitoring and Elkem has participated in the 'Fjordgruppa' in Kristiansand for many years. This is a collaboration between local authorities, county governors and local industrial actors with links to the Kristiansand fjord. Elkem Bjølvefossen has on its own initiative monitored mussels since 2002, after it closed its landfill sites. Monitoring water is new for Elkem's plants in Thamshavn and Salten, and the plants will, as in Bjølvefossen, mainly monitor potential run-off from its landfill sites to nearby rivers and the fjord in 2015. Monitoring water sources near industry and landfill sites is generally a good supplementary method for checking Elkem's own emissions. It also helps discover any adverse environmental effects that may be building up in the fjord (or other bodies of water) over a longer period.

Monitoring in 2015

All the plants will now monitor water in line with the requirements of the Water Regulations. For some of the plants this actually means reducing the scope of their previous water monitoring programme. The Elkem plants' monitoring programmes were approved by the Norwegian Environment Agency in the first quarter of 2015. The programmes describe various measurement parameters such as the possibility for mussel consumption and sediment contamination, all depending on what is relevant for the individual plant. The monitoring will take place during the summer/early autumn of 2015. The results will determine whether or not the monitoring will continue for the rest of 2015. This decision will be made by the Norwegian Environment Agency in consultation with the consultants who will take samples and assess the results of the monitoring.

Natural boundaries

The EU Water Framework Directive will be implemented in Norway via the Regulations on a Framework for Water Management (Water Regulations). The goal of legislation is to ensure that water is well managed regardless of local authority, county or national borders, and that each river basin district will, over time, achieve defined environmental goals. It is the catchment area and natural boundaries that determine which river basin areas should be viewed together. The causes of any poor environmental conditions must be identified so that relevant measures can be implemented to achieve improvements.

The Ministry of Climate and Environment bears national responsibility for coordinating and following up the Water Framework Directive in Norway. The responsibility for implementing measures and monitor these will be divided according to the 'polluter pays' principle.

The Water Regulations divide Norway into eleven water regions. The regions vary greatly with respect to size and the challenges they face. The water region authority must ensure the work is well coordinated and guide it by putting in place plans and measures for each region. Each body must attain better environmental goals over a six-year plan period, i.e. by 2021, 2027 or, in exceptional circumstances, 2033.

Profitable growth from a solid base

In 2014 the Elkem group achieved an annual profit after tax of NOK 303 million following growth in turnover of 11 per cent. Better markets, stable operations and favourable exchange rates made positive contributions to our financial performance in 2014. The company also expects profitable growth in 2015. Elkem has solid equity and almost no interest-bearing debt.

Elkem's operating income in 2014 was NOK 8,652 million, compared with NOK 7,789 million in 2013, a rise of 11 per cent. The increase was due to better prices, favourable exchange rates and higher volumes.

The net operating profit (EBIT) was NOK 611 million, compared with NOK 418 million in 2013, an increase of 46 per cent. Greater demand for Elkem's products also led to higher selling prices. In addition to this, a weaker NOK exchange rate had a positive impact on the result, although it also resulted in higher prices for raw materials. High capacity utilisation resulted in somewhat higher costs as well. The weaker NOK produced losses in the group's currency hedging programme.

The annual profit after tax was NOK 303 million, compared with a loss of NOK 628 million in 2013. The annual result for 2013 was negatively impacted by Elkem Solar to the tune of NOK 477 million. In 2014, Elkem Solar was deconsolidated from the Elkem group after Guangyu International acquired 50 per cent of the shares in March 2014. In 2014, Elkem's share of the result in Elkem Solar was included on the income statement line 'income from associated companies and joint ventures'.

The equity in the Elkem group amounted to NOK 8,757 million at year-end 2014. The equity ratio was 79 per cent, inclusive of minority interests. The company had almost no interest-bearing debt. The company is owned by Bluestar Elkem International in Luxembourg, which in turn is controlled by the China National Bluestar Group.

Solar business

In 2014, Elkem Solar was deconsolidated from the Elkem group after Guangyu International acquired 50 per cent of the shares in March 2014. In November 2014 Bluestar Elkem Investment HK announced an agreement to purchase 100 per cent of the shares in REC Solar. The plan is to optimise the value chain from quartz extraction through to sales of finished solar cell modules. This will be done through a close partnership between Elkem Solar's plant in Fiskaa in Norway and REC Solar's plant in Singapore.

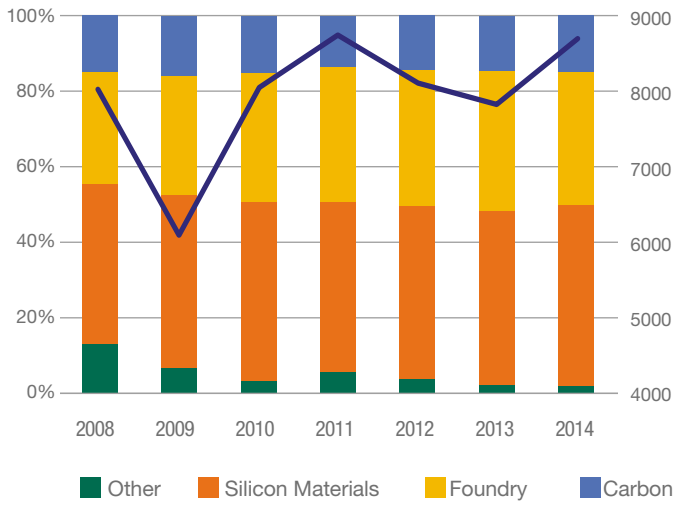
Investments and R&D

Developing new, sustainable materials and production methods is considered strategically important to securing a solid market position in the future.

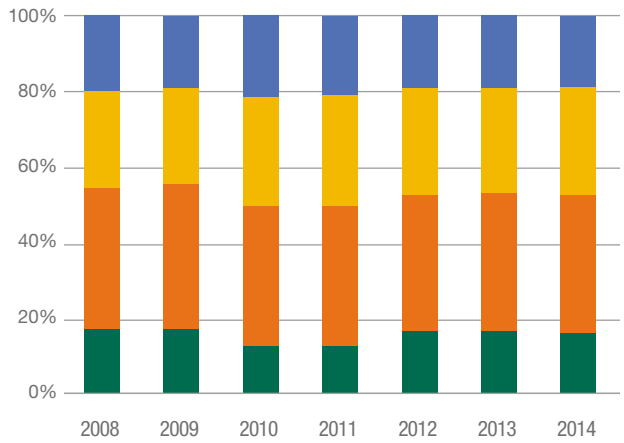
Elkem spent NOK 99 million on research and development in 2014. Among the most important projects are measures for increasing furnace efficiency, reducing the formation and emissions of NO_x and dust, and developing a completely new method for carbon neutral metal production.

NOK 546 million was invested in 2014. NOK 102 million of this was defined as strategic investments. This includes the construction of an electrode paste plant in Malaysia, a new ferrosilicon production plant in Paraguay (joint venture), the acquisition of MSC Europa GmbH, and a new energy recovery facility in Bjølvefossen.

OPERATING INCOME BY BUSINESS AREA NOK MILL.



EMPLOYEES BY BUSINESS AREA



Elkem Technology

Elkem is dedicated to advancing the production of metals and materials through long term R&D and innovation projects. Through Elkem Technology more than 150 R&D professionals cooperate with notable research institutions around the world to develop more efficient, sustainable and advanced processes and products that the world needs.

Elkem's future is carbon neutral

Elkem is among the world's cleanest metal manufacturers but still emits around 1.3 million tonnes of CO_2 each year. This may now be coming to an end. A research project in Elkem will lay the groundwork for full scale production without net CO_2 emissions and without a net supply of energy.

It has long been acknowledged that it is possible to replace fossil coal with charcoal, thus substantially reducing net CO_2 emissions depending on the amount of charcoal used. Quartz consists of silicon and oxygen. The job of the carbon is to release the oxygen. This takes place in a chemical reaction at high temperatures. Charcoal may increase the yield from the process, meaning more silicon can be extracted from the quartz.

Revolution

But Elkem's ambitions are greater than this: Elkem is conducting research into the possibility of producing charcoal at the same plant where ferrosilicon and silicon are produced and connect these production cycles to a thermal power plant. At optimal levels, the power generated will be greater than the power consumed. It will also be possible to produce condensate, which can then be refined.

The research project has been named Carbon Neutral Metal Production (CNMP) and has been awarded NOK 7 million in funding from the Research Council of Norway over a two-year period. Elkem's own investment will be just over NOK 8 million in the same period. The results of the project could in the long-term, change how metal is produced around the world with the corresponding positive impact on CO_2 emissions from smelting plants. To date, producing the metals the world needs to build renewable energy sources such as solar power and windmills has been inextricably linked to the CO_2 emissions from the metal production. Elkem hopes to find an answer to this dilemma.

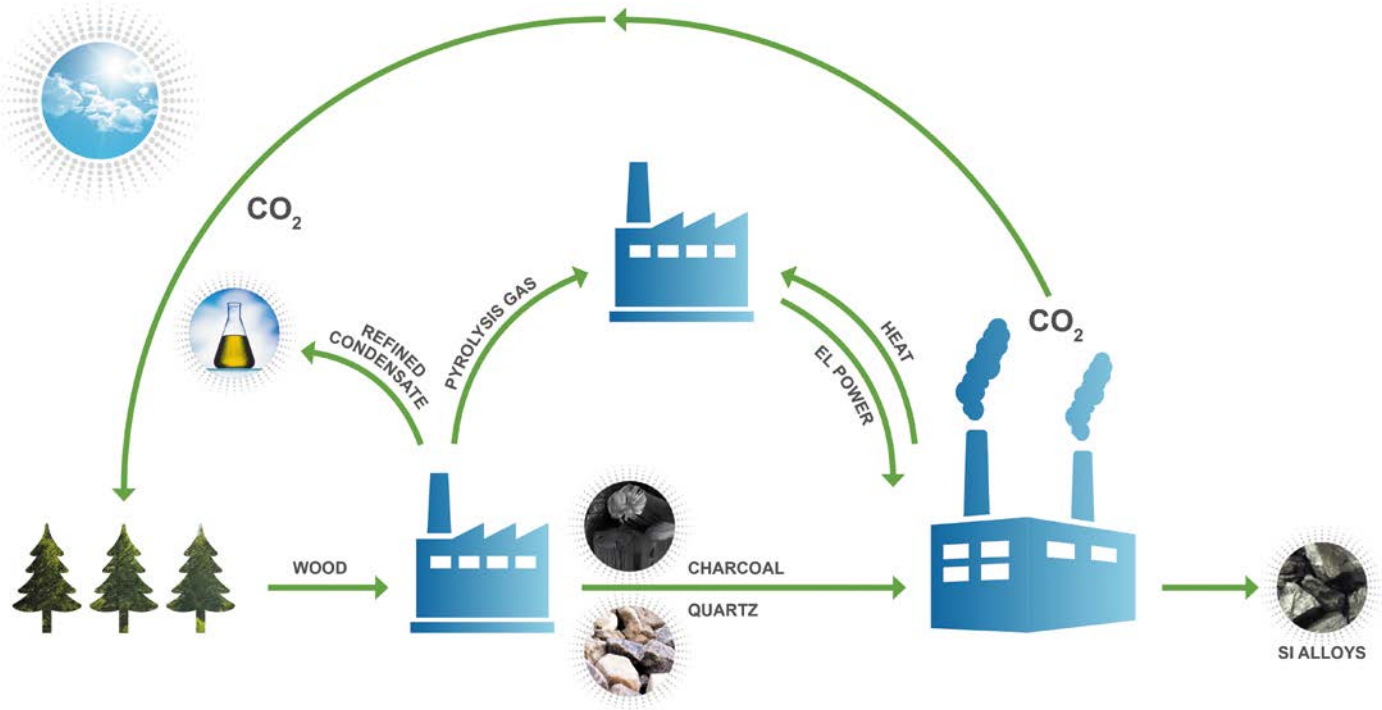
Research into zero waste

Elkem's technological partners in the project are SINTEF Energy Research and Teknova. The research project is scheduled to conclude by the end of 2016. Elkem will then decide whether the project will be continued with large-scale tests in laboratories and industrial pilot plants.

CNMP is based on Elkem's principle of zero waste: all the materials and energy put into production must be utilised.

Elkem has applied for patent protection for CNMP, which will involve connecting three plants:

- A pyrolysis plant for the production of charcoal and condensate.
- A smelting furnace for the production of ferrosilicon or silicon.
- A thermal power plant for the production of electricity.



Si 2020 – improved production process

The basic principles of silicon production are around 100 years old. A number of different improvement measures have resulted in a considerably better process. In 2011 Elkem decided to start a research programme that would carry out a thorough review of each step of the production process to examine the residual potential that remains with regard to better material yield and reduced losses, lower emissions, and more efficient energy consumption.

The Si 2020 research programme is a ten-year research project in Elkem that aims to improve the entire production process for silicon (Si) and ferrosilicon (FeSi), from the choice and supply of various raw materials to casting metal and the finished silicon product. Si 2020 has identified a huge potential. The goal is to find and develop new technology and production methods that can increase the silicon yield in the processes, from quartz to finished product, while lowering energy consumption and emissions and making the processes cleaner and safer for employees.

The Si 2020 programme consists of various sub-projects that focus on selected steps in the production, as shown in the figure below. Between 2012 and today, research projects have been started in the following areas:

1. Improving Elkem's understanding of the properties of raw materials and how these affect the process.
2. Improving Elkem's understanding of fundamental aspects of designing and operating smelting furnaces.
3. Developing new methods of monitoring furnace surfaces.
4. More efficient refining of silicon and ferrosilicon.
5. Investigating how thin casting silicon can reduce losses and improve product quality.

Broad research

The goal of the Si 2020 programme has been to establish research projects at universities and university colleges that are directly linked to the internal projects and are supported by the Research Council of Norway and the EU. The following research projects have been established as part of the Si 2020 programme:

- **ESiP**'s goal is to improve energy consumption in the furnace process by developing a new operation support system that utilises new measurements, new understanding, and new mathematical models of what is happening inside the smelting furnaces. Other participants: Cybernetica and SINTEF.

- **BiOCarb+** is tasked with developing new knowledge about production and the use of biomass as a reduction material in FeSi and Si processes. Other participants: SINTEF ER, NTNU, NFLI, Eyde-network and Norsk Biobrensel AS.

- **SiNG** is looking into how natural gas can be used as a reduction material in FeSi and Si processes and studying chemical reaction patterns in smelting furnaces with the aim of increasing the extraction percentage of silicon by 5 per cent. Other participants: SINTEF and NTNU.

- **CoRReSi** is developing a new concept for the refining process through actively controlling the temperature during the refining process and through basic research into the chemical reactions that take place in the metal ladle during the refining. Other participants: SINTEF, Teknova and KTH in Stockholm.

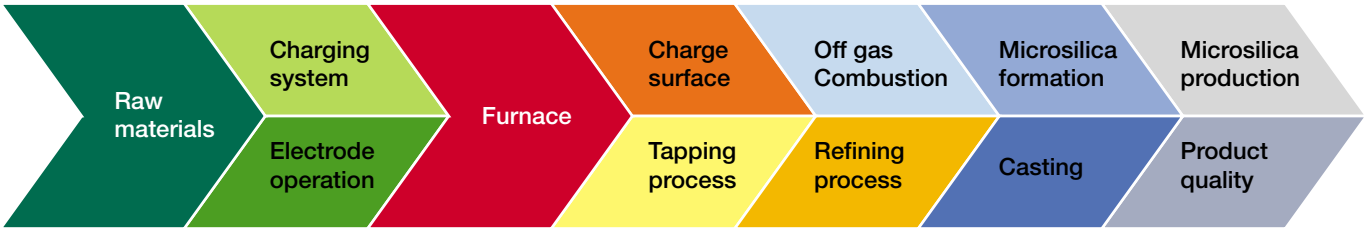
- **CorSiCa** is tasked with developing mathematical models of how casting silicon and the subsequent cooling determines product quality and recommend equipment designs and operation methods to utilise this new knowledge in operations. Other participants: SINTEF and Teknova.

- **ReCoBa** is an EU project aimed at improving process control during refining and casting. The project has ten participants from a number of countries. Other industrial companies involved include BASF and Thyssen Krupp.

Improved energy efficiency

The ESiP (Energy efficient Silicon Production) research project consists of subprojects 1, 2 and 3 in Si 2020 and includes the development of methods for monitoring furnace surfaces, studies at SINTEF of material and energy flows in the furnace process, and mathematical modelling of the furnace process at Cybernetica. ESiP's goal is to improve energy efficiency in silicon production

POSSIBLE IMPROVEMENTS IN EACH STEP OF THE PRODUCTION PROCESS



through the use of a new operation support system that will be developed on the basis of new measurements, new process understanding, and mathematical models. The project has received funding from the Research Council of Norway for 2013-2016.

Silicon is extracted from quartz. With the current methods of silicon production 80-85 per cent of the silicon is extracted. The goal of the ESiP research project is to increase the utilisation of the raw material by at least 5 per cent without increasing energy consumption. By managing the production processes better, Elkem can achieve energy savings of 200 GWh, if the method can be implemented throughout the group. The Si 2020 programme focuses on maximising the silicon yield from raw materials to the finished marketable product.

Producing results

Elkem has already seen that Si 2020 has produced results. Findings from the ESiP project have already been used in the operation of the smelting furnaces.

- Camera systems have been installed to monitor the furnace surfaces at two smelting plants. The new systems have proved important aids in managing the furnace.
- New knowledge has been developed about how the material properties of the quartz raw material affect the furnace process. A new test and measurement programme for quality assuring quartz has been established based on this new knowledge.
- The mathematical models for the furnace process and new process knowledge has been used to establish new, improved operating methods for a smelting furnace in one of the smelting plants. This has resulted in better operational stability and a very high silicon yield from this furnace.

Elkem University

The dissemination of new knowledge to the rest of the Elkem organisation is a priority task. The main channel for this is the Elkem University, where process engineers and other employees from Elkem's melting plants take part in a one week 'university' with lectures on fundamental process knowledge at which the results from the Si 2020 projects are presented. The Si 2020 programme also offers shorter courses in specific fields. The Si 2020 programme also includes doctoral programmes at NTNU and KTH.

Bringing industry together at a new research centre

A research centre headed by the Norwegian University of Science and Technology (NTNU) will ensure that the Norwegian metallurgical industry remains a world leader within energy-efficient, environmentally friendly and competitive production. Key Norwegian metal manufacturers were behind its establishment, including Elkem.

From April 2015 the Norwegian metallurgical industry will stand together behind the name SFI Metal Production. SFI is an abbreviation for the Norwegian name of the Centre for Research-Based Innovation (Senter for Forskningsdrevet Innovasjon) and is a programme run by the Research Council of Norway. The member companies include manufacturers of ferroalloys, aluminium and titanium, academic institutions and the supply industry.

The project is scheduled to run for eight years and has a total budget of NOK 247 million. NOK 102 million has been contributed by the industry, NOK 96 million has been contributed by the Research Council of Norway and NOK 50 million has been contributed by academic institutions. The plan is to provide 15 new PhD studies in disciplines that fall within the project's research fields.

Three main goals

• **Sustainable innovation:** to provide industry in Norway with the best possible conditions for developing new, sustainable products and greener and more energy and cost-effective production processes.

• **World leading research**: to combine resources for implementing, testing and experimenting in industrial pilots to form the basis for ground-breaking global projects.

• **Industrial growth**: to create the foundations for quicker implementation of technological breakthroughs and ensure a more uniform utilisation of these in a total production run. This will produce competitive advantages that will provide a basis for growth and the formation of new companies.

Five research areas

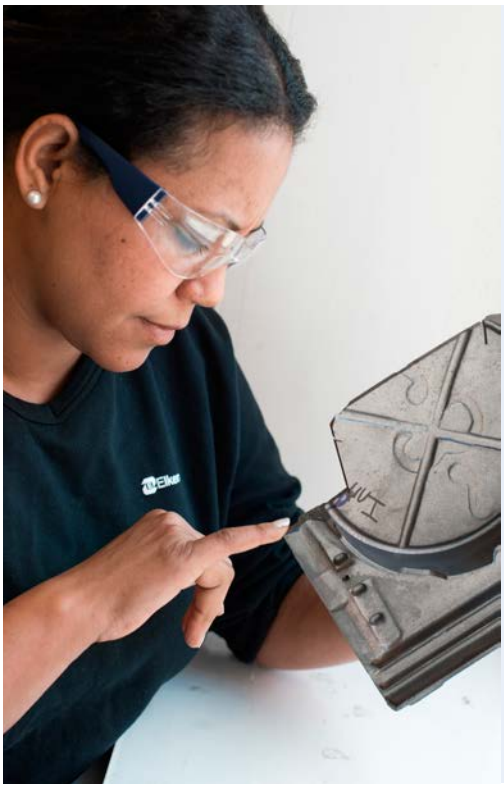
• **Developing modelling tools for basic conditions**
NTNU and SINTEF have implemented a number of collaborative projects with the industry in order to quantify how materials develop throughout the production processes. There is a need for exact data in order to describe the materials' properties in various conditions. The development of computer tools to optimise production would be of considerable practical significance for the industry.

• **Primary metal production**
Metal production requires access to large quantities of good raw materials and energy, and the processes involve heavy CO_2 emissions. Improved knowledge about raw materials is in all of the project participants' interests. The same applies to process improvements that could reduce energy consumption.

• **Refining and recycling**
Recycling materials is becoming increasingly important, however in order to manufacture metals with the desired properties based on recycled metal it must be possible to remove impurities. Research is also needed into the utilisation of all side-flows and waste/slag from production.

• **Emissions and the environment**
Norwegian producers lead the world when it comes to environmental performance, low emissions and using the best available technology (BAT). Nevertheless, there is a clear expectation from both the industry and society that we need to do even better.

• **Metals and society**
This field of research is based on some dilemmas linked to the production of metal.
- Metal production is based on limited raw materials.
- The earth's critical levels have already been exceeded in many areas.
- Today's social and environmental challenges cannot be solved by market forces alone.



Project participants

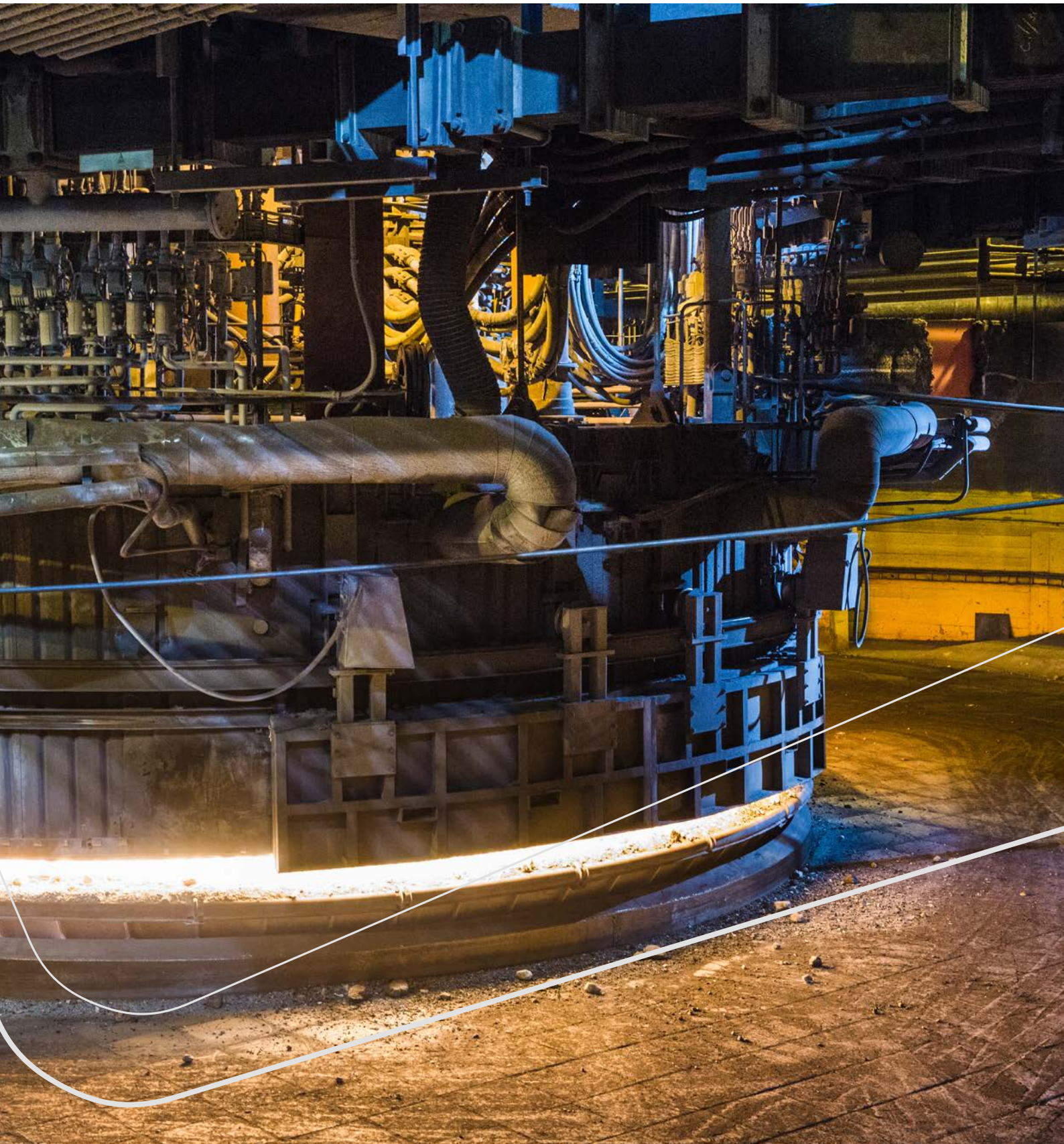
Academic institutions:
NTNU, SINTEF and Teknova

Industry:
Hydro, Alcoa, Elkem, Eramet Norway, FESIL, Finnfjord, Glencore Manganese Norway, Wacker Chemical Norway, Tizir Titanium & Iron and Alstom.

Glencore Nikkelverk and Boliden Odda (zinc production) are likely to join as partners from 2018.

Elkem Silicon Materials

Elkem Silicon Materials is Elkem's largest business area and one of the world's leading suppliers of metallurgical silicon and microsilica. Elkem Silicon Materials supplies special products to customers in the chemical, solar, electronics, aluminium, construction, refractory, and oilfield industries worldwide.



ELKEM SILICON MATERIALS

Promising research into silicon batteries

Elkem's research department has been continuously charging and discharging a silicon test battery since September 2014. The results so far are promising: the capacity of the battery is more than that of current lithium batteries.

The more efficient the battery, the more useful electricity becomes as an energy source. Silicon for batteries could be a large market for Elkem. If this is achieved, as most people believe it will be, this could be a market in which Elkem could deliver thousands of tonnes a year. More efficient batteries will also make solar energy, which is one of Elkem's most important ventures, more useful.

Special silicon

Elkem is carrying out research into developing the silicon material that works best in batteries. Elkem currently sells special silicon, Silgrain® e-Si, produced at the plant in Bremanger. Customers use Silgrain® e-Si in battery tests, or in silicon/lithium batteries. The watchmaker Breitling is one of the companies that have started using such batteries. Silgrain® e-Si was developed in collaboration with a Japanese research centre, AIST Kansai.

In theory it will be possible to increase battery capacity tenfold by using silicon as the anode. The problem with silicon, however, is that it expands 400 per cent when it reacts with lithium during discharge. This can lead to the pulverisation of the anode, meaning the battery cannot be recharged.

Silicon and graphite

Elkem has its own divisions of specialists on both carbon and silicon who, together with the Institute for Energy Technology (IFE) and SINTEF have tried to find mix proportions with silicon that can withstand enough charging cycles for it to be used in, for example, a car. Gluing together microscopic particles of silicon and graphite leaves enough room in the structure for the silicon elements to expand and contract without the substance being pulverised.

In 2015 Elkem Technology will conclude a three-year research project into the use of silicon as the anode in lithium batteries. Ongoing tests indicate that the new anodes more than double the storage capacity of lithium batteries compared to today's graphite anodes.

Vision 2050 and leadership

The **Vision 2050** document from World Business Council sets a vision for the future: In 2050 9 billion people live well within the limits of our planet. To get there we must all dramatically change course.

In Elkem we believe that the innovative power of the business sector will and must make a huge contribution to get the world on track toward the Vision 2050 scenario. We also believe that the companies that deliver the innovative solutions the world needs will be those that succeed. Good future solutions will contribute to lower emissions, more efficient raw material utilisation and greater energy efficiency.

Elkem's Leadership programme is a two-year management development programme for management talents in Elkem. The programme includes participants from Norway, Spain, India, Iceland, Denmark, Canada, China, the Netherlands and Germany, who have varied backgrounds and ties to the various business areas in Elkem. As part of the programme some of the participants have been asked to prepare a report on whether they believe Elkem has what it takes to survive the future scenario outlined in Vision 2050. The group will submit its analysis to Elkem's executive management group in the autumn of 2015. A number of measures have already been identified that indicate that Elkem is on the right path in many areas when it comes to contributing to the solutions that are sought in Vision 2050.

Representatives from the Leadership group together in Kristiansand: Bente Håland (Norway), Ivar Helvik (Norway), Florensio Quiros (Spain), Lotte Harlø (Denmark), and Brajesh Malviya (India).

Continuous processing saves energy

In 1918 Elkem patented a method that freed smelting plants from having to cool down furnaces and stop production when the electrodes were exhausted and had to be replaced. The method is called the Söderberg method. The invention led Elkem to become a worldwide technology company. Around 75 per cent of all smelting plants and furnaces worldwide use technology and equipment purchased from Elkem.

Even smaller CO_2 footprint for solar cell electricity

Elkem Solar, which was established in 2009, produces silicon for the solar cell industry. Elkem's method means that the production only consumes one quarter of the energy consumed by competitors. Ongoing development will reduce the energy consumed even further. This makes solar cell energy even more climate friendly.

Environmental problem becomes a profitable product

Thick, white smoke used to pour from the silicon smelting plants' chimneys. A big environmental problem, but also the worst kind of waste: the smoke contained a profitable product with fantastically useful properties. Elkem Microsilica® is an emissions problem that has been turned into a profitable product. Elkem developed the scrubbing process and identified uses for the silicon dust. This has resulted in a far lower impact on the environment from silicon plants the world over.

CO_2 neutral metal production

To date, producing the metals the world needs to use renewable energy sources such as tsolar power and windmills has been inextricably linked to CO_2 emissions. Metal production also requires great quantities of energy. The aim of Elkem's ground-breaking CNMP (Carbon Neutral Metal Production) research project is to find a solution to this dilemma.

The goal is for Elkem to produce charcoal that will replace fossil coal at the same plant that produces ferrosilicon and silicon. These production cycles will be connected to a thermal power plant. In an optimum thermal power plant the power generated will be greater than the power consumed. It will also be possible to produce bio-oil, which can then be refined. The results of the project could in the long-term change how metal is produced around the world with the corresponding positive impact on CO_2 emissions from smelting plants.

The research project is scheduled to conclude by the end of 2016. Elkem will then decide whether the project will be continued with large-scale tests in laboratories and industrial pilot plants.

40 per cent lower NO_X emissions

Furnace 2 at Elkem Salten was upgraded in the spring of 2013. The rebuild reduced the furnace's NO_X emissions by 40 per cent. A similar rebuild will be carried out on a number of Elkem's furnaces and Salten Furnace 3 is first in line.

Nitrogen oxides (NO_x) are exhaust gases that cause acid rain and higher concentrations of ground-level ozone. These emissions can be harmful to ecosystems and vegetation and also to health. Elkem's solution provides opportunities for considerably lower NO_x emissions for the smelting industry worldwide.

A green alternative

A lot of research and testing remains, but Elkem Carbon has already marketed and introduced a product in which coal tar pitch has been replaced with a binder based on substances from wood. ELSEAL® Type G has been developed for the aluminium industry. A steadily increasing number of customers want to use this new product that contains no PAHs or other hazardous substances, does not require the use of protective masks during installation, and does not produce hazardous waste.

Systematic continuous improvement

More sustainable solutions are achieved through both technological leaps forward and continuous improvements. Eliminating all forms of waste is at the core of Elkem's definition of what continuous improvements entail: all of the raw materials and energy put into production must be utilised. Elkem Business System (EBS) provides the foundation for Elkem's corporate culture and operating philosophy, and is an important weapon in the fight against waste. EBS describes how Elkem's employees at all levels should conduct themselves and how the organisation should collaborate to achieve continuous improvements.

ELKEM SILICON MATERIALS

International language of improvement

Traditionally Elkem Business System (EBS) has been used at the plants, as an improvement tool. Elkem Silicon Materials has systematically tried to ensure that all employees in the division work according to the principles in EBS. The result is increased competitiveness.

Elkem Business System (EBS) describes how employees at all levels should conduct themselves and how the organisation should work together to achieve common goals and continuous improvement. Because EBS is the essence of Elkem's corporate culture and operating philosophy, it is important that it is really ingrained in all employees.

That is why the whole of Elkem Silicon Materials' organisation in Europe, America and Asia for two years have worked on how the division can use EBS to improve its competitiveness. Elkem Business System (EBS) has expanded from being an improvement tool for the plants to also cover purchasing, sales and marketing departments, finance and economics, HR and legal departments.

Common platform

Elkem Silicon Materials operates in many countries. This extensive EBS process has shown that EBS provides employees with different professional backgrounds, different areas of responsibility, and different cultural backgrounds with a common frame of reference. Thanks to the EBS training, which practically all employees in the organisation have undergone, a common 'language of improvement' has been established that everyone understands. EBS provides a common cultural platform across national boundaries and professional affiliations.

After two years, the results are as follows:

- Better process stability at all plants
- Greater yields from most furnaces
- Greater uptime
- Fewer quality non-conformities
- Lower maintenance

Learning from tangible situations

At the core of EBS are improvements. When Elkem's employees learn how to use EBS, it is first and foremost through working on concrete situations where improvements are required.

One case that was chosen in the EBS training in Shanghai involved how to reduce the turnover rate, i.e. how many employees leave in the space of a year. The turnover rate in Shanghai companies is generally around 18 per cent. This is very high and means that companies in Shanghai spend an unnecessarily large amount of resources on recruitment and training new personnel.

Elkem's business in Shanghai is more fortunate with turnover of less than 5 per cent. The HR department drew up a case that involved how Elkem could manage to sustain this low turnover rate. What has a positive effect that makes people want to stay with the company? What do the competitors offer? Are new measures needed to sustain this low rate? The participants in the workshop were Elkem's employees in sales and administrative positions in China and other Asian countries.

Elkem Silicon Materials' plants

Elkem Bremanger, Norway

Established	1928
No. of employees	105
Produces	Silicon for electronics and solar cells. Elkem Microsilica® for concrete and oil wells.
Certifications	ISO 9001 certified since 1990. ISO 14001 certified since 1999. ISO/TS 16949 certified since 2007. Certified in accordance with EN 13263-1:2005 Microsilica® for concrete.

Elkem Salten, Norway

Established	1967
No. of employees	165
Produces	Silicon for aluminium, chemicals (silicones) and electronics/solar cells. Elkem Microsilica® for concrete, refractory materials and polymers (plastic/rubber).
Certifications	ISO 9001 certified since 1991. ISO 14001 certified since 1999. Certified in accordance with EN 13263-1:2005 Microsilica® for concrete.

Elkem Thamshavn, Norway

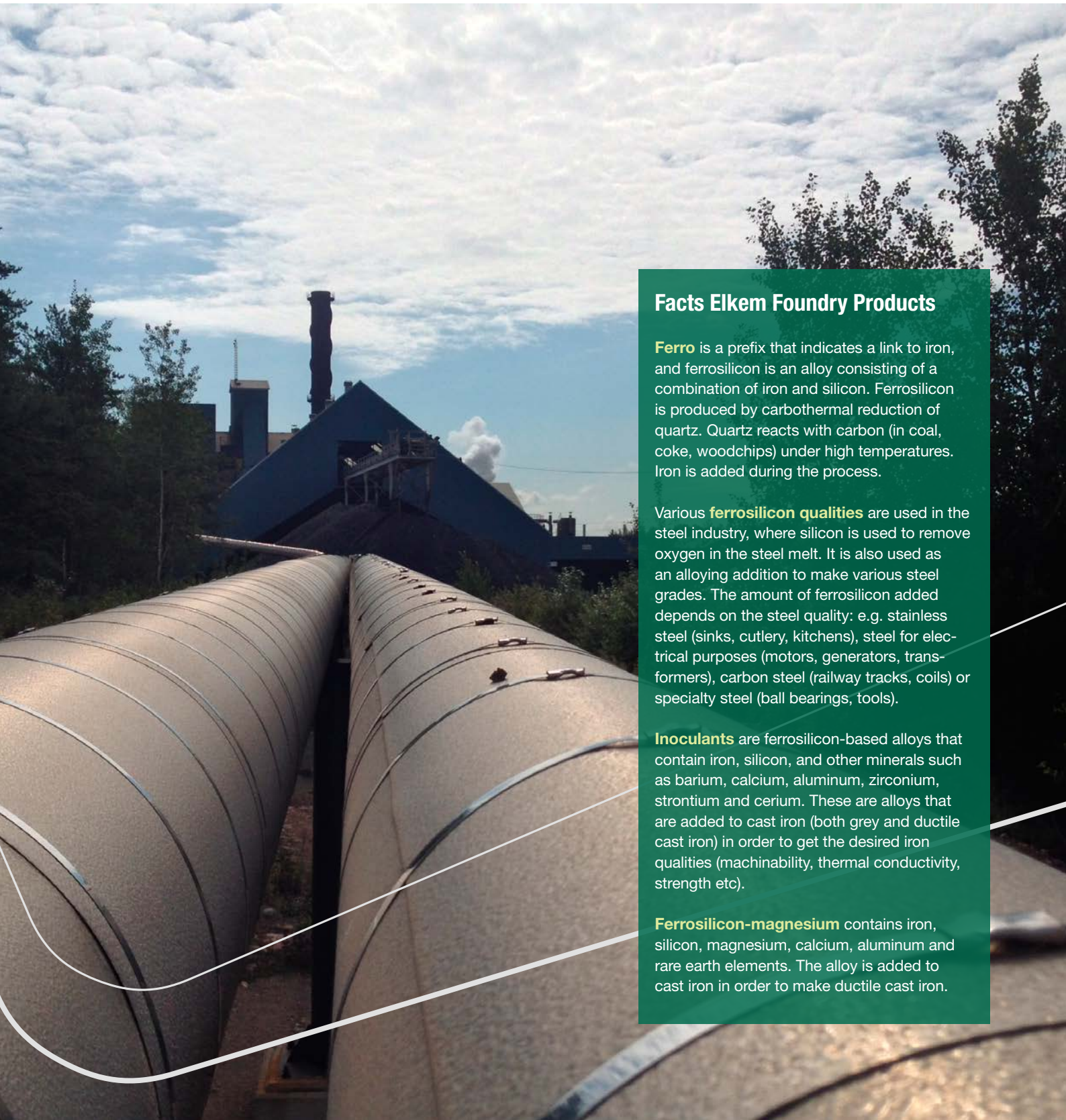
Established	1930
No. of employees	155
Produces	Silicon for chemicals, aluminium and solar cells. Elkem Microsilica® for concrete and refractory products.
Certifications	ISO 9001 certified since 1992. Certified in accordance with EN 13263-1:2005 Microsilica® for concrete.

Elkem Tana, Norway

Mine established	1973 by Sydvaranger AS, acquired by Elkem 1983
No. of employees	38 of whom 22 are employed by Elkem Tana and 16 by a subcontractor.
Produces	Quartzite for the ferrosilicon and silicon industry, both for Elkem and for external plants.
Certifications	ISO 9001

Elkem Foundry Products

Elkem Foundry Products is a leading supplier of metal treatment solutions to the cast iron industry and also supplies high quality, specialised ferrosilicon products to the steel industry. The products, which are well-supported by our experienced technical service teams, provide innovative solutions for iron foundries and steelworks worldwide. Our main customers are the car industry, pipe manufacturers and engineering companies.



Facts Elkem Foundry Products

Ferro is a prefix that indicates a link to iron, and ferrosilicon is an alloy consisting of a combination of iron and silicon. Ferrosilicon is produced by carbothermal reduction of quartz. Quartz reacts with carbon (in coal, coke, woodchips) under high temperatures. Iron is added during the process.

Various **ferrosilicon qualities** are used in the steel industry, where silicon is used to remove oxygen in the steel melt. It is also used as an alloying addition to make various steel grades. The amount of ferrosilicon added depends on the steel quality: e.g. stainless steel (sinks, cutlery, kitchens), steel for electrical purposes (motors, generators, transformers), carbon steel (railway tracks, coils) or specialty steel (ball bearings, tools).

Inoculants are ferrosilicon-based alloys that contain iron, silicon, and other minerals such as barium, calcium, aluminum, zirconium, strontium and cerium. These are alloys that are added to cast iron (both grey and ductile cast iron) in order to get the desired iron qualities (machinability, thermal conductivity, strength etc).

Ferrosilicon-magnesium contains iron, silicon, magnesium, calcium, aluminum and rare earth elements. The alloy is added to cast iron in order to make ductile cast iron.

ELKEM FOUNDRY PRODUCTS

Elkem helps lower car industry emissions

In its pursuit of climate friendly solutions, the car industry is choosing engines made of cast iron to meet the requirements for low CO_2 emissions. Elkem Foundry Products supply vital input for modern car engines.

Transport accounts for around one quarter of global CO_2 emissions. The greatest contributor is the private car fleet. Both the EU member states and other countries have therefore passed regulations that force through significant reductions in emissions. The EU has adopted regulations that state that all new cars must have maximum emissions of 130 grams CO_2 per kilometre in 2015 and 95 grams per kilometre by 2021. The reduction from 2015 to 2021 will be 26 per cent. The reduction from the level in 2007 will be 40 per cent.[1]

Lighter cars

CO_2 emissions are proportional to fuel consumption. In the pursuit of more energy efficient cars there are a lot of factors at play, but two things are the most important: Reducing the weight of cars and increasing the engine's utilisation of fuel. Since the engine is the heaviest part of the car, the engine is also key to more energy efficient cars.

New cars are being built with turbo chargers to increase the energy efficiency of the engine. This means that the engines do not need to be as large, although the higher pressure and temperatures in the engines does mean that they have to be more solid.

Myth on cast iron

Because cast iron is three times as heavy as aluminium it is a common perception that a cast iron car engine must be heavier than a similar one in aluminium. This is not correct. Cast iron is stronger and stiffer than aluminium and can, therefore, be produced with thinner walls, which makes them lighter.

Environmental benefits

Using cast iron also has other environmental benefits:

- The production of cast iron is up to ten times less energy intensive than the alternatives.
- 100 per cent of the cast iron produced with input from Elkem can be recovered.
- The cast iron industry represents an important part of the recovery industry: 80-90 per cent of the iron that is produced usually comes from recovered scrap.

Less waste – better products

Elkem Foundry Products is always looking for more efficient and environmentally friendly solutions for its production processes. Using renewable energy, recovering heat from the furnaces, and utilising all residues is part of Elkem Foundry Products' strategy.

Production mistakes are expensive and not environmentally friendly. Elkem Foundry Products' job is to produce alloys that improve the production process of iron foundries and steelworks the world over. Technical experts (the service team) from Elkem Foundry Products visit customers around the world to ensure they are using alloys that are suitable for their end products and the production process.

Elkem Foundry Products' service team gathers several times a year to share experiences. This means that customers always have access to the best practices from around the world. This is one example of how Elkem's vision of zero waste is disseminated.

A special market manager was appointed in 2014 who specifically focuses on the car industry to help them achieve their goals.

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Cast iron

- Inoculants are added to ensure the cast iron achieves the properties the end product requires. This is ferrosilicon with aluminium, calcium, barium, zircon, strontium or cerium added.
- Adding Elkem's alloys enables iron foundries to produce iron products with the best possible properties and with low error margins with respect to mechanical properties, surface quality, machinability and casting mistakes. All foundries are different. Elkem therefore has many different inoculants and around 100 different ferrosilicon-magnesium qualities to choose from.
- Cast iron has been in use for more than 2,500 years.

1) http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

ELKEM FOUNDRY PRODUCTS

Zero waste to landfill

A clear goal has been set for Elkem Foundry Products' plant in Iceland: nothing from the production process should end up in landfill sites. Without any increased cost, impressive progress has been made.

In 2010 34 per cent of all side streams from the plant's production ended up in landfill sites. In 2011 the management and employees set a clear goal for themselves: zero waste to landfill.

No time limit was set because no one knew how this ambitious goal should be achieved in detail. Instead, goals were set for a year at a time, based on ideas and knowledge they accumulated. This method has produced results: from 35.4 per cent ending up in landfill sites in 2010, the plant was down to 11.3 per cent in 2014. In 2015, the goal is to get below 10 per cent.

Good finances

Achieving the goal of 100 per cent recovery of the side streams has necessitated changing the culture at the plant. The word 'waste' is no longer used: all side streams are resources with potential value and should be described appropriately.

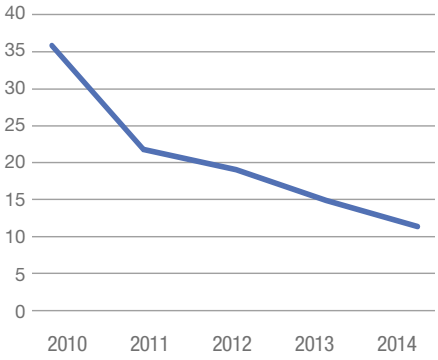
One prerequisite for implementing measures is that they should not increase costs; rather they should improve the financial situation. This double sustainability principle means that the risk of setbacks is reduced, because the recycling of side streams also has positive financial results.

There are many physical side streams in a large ferrosilicon plant: ore, 'fines', timber, plastic, iron, paper, cardboard, food waste and so on. The idea is to reduce the waste and thereafter sort it. What can be used in the plant's own production is put back into the process. What Elkem cannot use is sent to other forms of recovery. Ultimately, one is left with fractions where no way of reusing or recovering has yet been found, that presently end up in landfill sites.

Working together

The vast majority ends up in a landfill site owned by the industry itself. The plant also has a 10 per cent stake in the recovery company Endurvinnslan. Elkem Iceland is working together with industrial companies throughout Iceland to find solutions that can increase reuse and lower landfill rates by offering to take over fractions that Elkem can use in its own production. This could, for example, be using recycled construction materials as a source of carbon during the smelting process. This produces lower net CO_2 emissions because the construction materials are biological and regarded as climate neutral.

PERCENTAGE OF WASTE SENT TO LANDFILL



More electricity from the world's oldest energy recovery plant

With support from Enova Elkem is expanding and upgrading the energy recovery plant in Bjølvefossen, which has been in operation since 1977. The investment means that the plant will increase the energy recovered from around 50 to 80 GWh per year. The electricity generated is fed into the grid.

The energy recovery plant in Bjølvefossen is to undergo a significant rebuild that aims to both improve energy efficiency and ensure that the plant complies with new statutory requirements. The project has a budget of NOK 116 million. The extensive upgrade of the plant started in October 2014 and is expected to be completed in February 2016. The plan for the plant is to generate 77 GWh by then. The electricity generated will be fed into the grid and cover the power consumed by around 4,000 Norwegian households.

Prescient

When Bjølvefossen's energy recovery plant was constructed in 1977, it was the world's first in the industry. Bjølvefossen has recovered energy from both of its furnaces since 1982. Energy prices at the time were very low, which made energy recovery not very profitable. Jon Kildahl, who was the managing director at the plant from 1981-1987, explains the background for the remarkable decision to make the investment back in 1974: 'The authority's order to scrub emissions from chimneys meant that the plant had to be modified. At the same time, the oil crisis in 1973 was an eye opener for the world for the need to improve energy consumption. Since the plant was going to be rebuilt, it was natural to try to find solutions in which the energy is used. For Elkem's part, the expectation of changes in the Norwegian power regime, with the end of state power contracts, was an important factor in the decision to make the investment.'

ELKEM FOUNDRY PRODUCTS

Energy efficient plant in Chicoutimi becomes even better

One of the furnaces in Elkem Foundry's plant in Chicoutimi, Canada, was expanded and redesigned in 2014. As well as increased ferrosilicon production, the rebuild resulted in more energy efficient furnaces and more recovered energy.

About 3 kilometres away from Elkem Foundry's plant in Chicoutimi, its neighbouring company, Rio Tinto Alcan, needs a lot of hot steam. This used to be met by a number of boilers fired by oil or natural gas. In 2013, Elkem opened a recovery plant that produces some of the steam the neighbouring plant needs. This means that Rio Tinto Alcan has reduced its consumption of heating oil and gas, and thus reduced its emissions of CO_2 and other exhaust gases.

More steam production

The power consumed by the furnace has increased from 28-30 MW to 34 MW in order to increase the production of ferrosilicon. This has resulted in the furnace producing more heat in the form of exhaust gases than before. The heat from the gas that goes to the recovery plant has also increased from 400 to 600 degrees Celsius. Both provide a basis for more steam production. The plan is to raise the exhaust gas temperature further to 700 degrees Celsius. This means that, under optimum conditions, the plant can produce 38 tonnes of steam per hour, which is equivalent to 210 GWh of recovered energy.

40 per cent lower CO_2 emissions

Rio Tinto Alcan's CO_2 emissions have been considerably reduced thanks to the steam from Elkem. The delivery of 140 GWh of steam reduces emissions by around 40,000 tonnes. The annual emissions of CO_2 from Elkem's plant in Chicoutimi are around 100,000 tonnes, meaning that 40 per cent of the emissions are indirectly offset by the neighbouring company. The upgrading of Elkem's plant will result in further reductions from Rio Tinto Alcan.

Elkem Chicoutimi is in every way a modern, sustainable production unit. The plant uses electricity generated by its own hydroelectric plant and the quartz is obtained locally. The plant uses a larger proportion of wood chips as a reduction agent than what is normal in the industry and leads the way when it comes to recovering 'fines', i.e. small particles of the finished material that would otherwise be regarded as waste. At Elkem Chicoutimi, this is added to the tapping ladle in molten metal that has just been tapped from the furnace. This means more product without higher energy consumption.

Surveyed footprint

In 2012 the university in Chicoutimi conducted a study of the CO_2 footprints of Elkem Chicoutimi's 20 most important products by surveying the emission of CO_2 equivalents throughout the production chain. This provides the customers with information about the CO_2 footprint Elkem Chicoutimi's products adds to the customer's own processes and products.

Elkem Foundry Products' plants

Elkem Bremanger, Norway

Established	1928
No. of employees	87
Produces	Ferrosilicon-based alloys (inoculants)
Certifications	ISO 9001, ISO 14001, ISO TS 16949

Elkem Bjølvefossen, Norway

Established	1905
No. of employees	154
Produces	Ferrosilicon-magnesium and various ferrosilicon grades
Certifications	ISO 9001 and ISO 14001 (ISO 50001 is planned Q4/2015)

Elkem Iceland

Established	1975
No. of employees	146
Produces	Various ferrosilicon grades
Certifications	ISO 9001, ISO 14001

Elkem Chicoutimi, Canada

Established	1967
No. of employees	96
Produces	Ferrosilicon-magnesium, ferrosilicon-based alloys (inoculants), various ferrosilicon grades.
Certifications	ISO 14001-2004 ISO 9001-2008

Elkem Foundry China

Established	2005
No. of employees	63
Produces	Ferrosilicon-magnesium
Certifications	ISO 9001:2008, OHSAS 18001-2007

Elkem Carbon

Elkem Carbon is a world leading supplier of carbon electrode materials, lining materials and specialised carbon products for metallurgical processes for the production of ferro-alloys, base metals and primary aluminium. Elkem Carbon serves the metallurgical smelting and primary aluminium industries.

ELKEM CARBON

Clean is profitable

The systematic work on combating dust has borne fruit for Elkem Carbon. The plants in Norway and China are leading the way in the battle against dust. In 2014, the requirement to wear a protective mask in the production hall at Fiskaa in Kristiansand was rescinded.

In 2010, Elkem Carbon set an ambitious goal of zero dust in production. Given that finely crushed, dried coal (anthracite) is one of its most important input factors, this was an ambitious goal. Many in the industry consider it impossible to achieve dust-free, clean production premises. However, systematic work on combating dust has produced very good results for Elkem Carbon. In Norway, dust levels are reduced from 4 mg/m^3 to 0.64 mg/m^3 in five years. The result for the first quarter of 2015 was 0.46 mg/m^3. Elkem Carbon's plant in China has also achieved very good results.

Virtuous circle

Changing equipment has a great effect: new equipment has better seals and is smaller, meaning the extraction is more effective. New sieves and new mixers result in large reductions in dust. Less dust in production premises provides opportunities to introduce automated solutions where the machinery would otherwise be unable to withstand the wear from dust. In turn, automated solutions result in less dust. For example, Elkem Carbon has considerably reduced the use of trucks and now uses conveyor belts for inwards transport in production premises. This avoids stirring up dust.

Interdisciplinary improvement groups work on dust reducing measures where the goal is to eliminate root causes. The strategy is to remove the largest sources of dust first. Eliminating these has enabled the company to achieve major dust reductions and the air and machinery are now so clean that even minor sources of dust are noticeable. These are sealed as they are detected.

Detecting dust sources is a regular task on all shifts. When dust leaks are detected, they are sealed immediately. Leaks are therefore never left open for very long.

In 2014 the plant in Fiskaa introduced a practice whereby production stops if the filter system stops. This has resulted in everyone paying extra attention to how the filter system is working and error correction takes place before the consequences become so serious that the filter system fails.

A fixed standard has been established in South Africa – Floor of excellence – for how the production plant should be fitted out. This means the gradual upgrading of each floor of the plant according to a set standard, which facilitates effective work against dust. According to the Floor of excellence standard all shifts must leave the production premises clean and tidy.

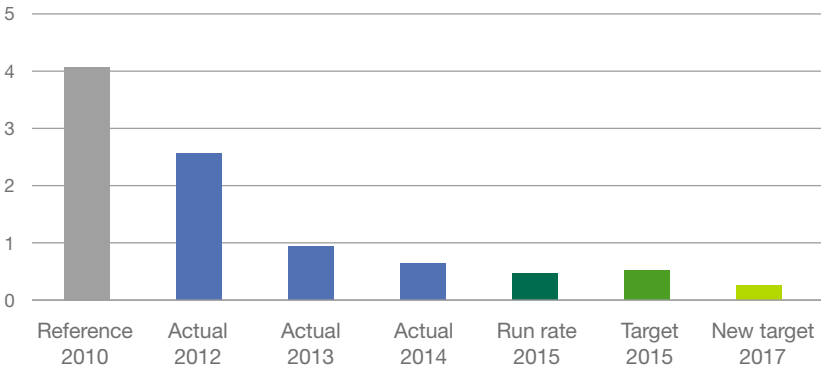
Inspiring

The dust reduction work is inspiring because it means a great deal for all parts of production. Primarily, dust reductions means a lot for employees. Elkem Fiskaa achieved an important goal in 2014 when the general requirement to wear a protective mask in the production hall was rescinded. Eliminating and sealing sources of dust provides control over a number of important factors:

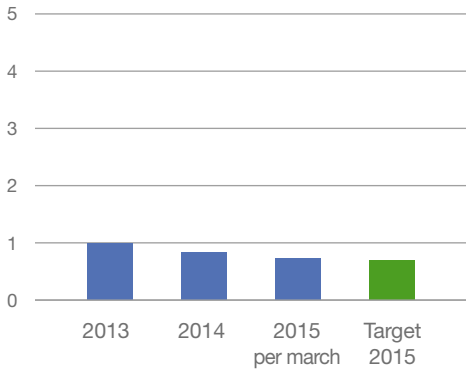
- Greater well-being thanks to a better physical working environment, because dust wears on people
- Greater operational stability for machinery and equipment, and reduced repair and maintenance costs because anthracite dust is abrasive and wears out equipment
- It enables the introduction of more cost saving automated processes and the use of equipment that cannot tolerate high dust loads
- Reduced pollution because dust can be a source of PAH emissions.

DUST EMISSIONS ELKEM CARBON FISKAA

mg/m^3 air



DUST EMISSIONS ELKEM CARBON CHINA mg/m^3 air



A green alternative

Coal tar pitch is an important ingredient in Elkem Carbon's products. It is also a substance that presents risks to health and the environment. Elkem Carbon is, therefore, in the process of developing a green alternative – a green binder – without known harmful effects. The project has been successful so far, but the work is complicated and requires a long time horizon.

Coal tar pitch is a fantastic substance from a technical perspective. It is solid at room temperature, liquid at 200 degrees Celsius, and transforms into a very solid material, with good properties for conducting electricity and heat, at around 1,000 degrees Celsius. In other words, it is a very suitable material for use in a smelting furnace. The disadvantage is that coal tar pitch contains polycyclic aromatic hydrocarbons (PAHs). A number of components are toxic, genotoxic or carcinogenic. The use of PAH containing products is expected to be even more strictly regulated in the future.

In order to develop a product that can replace coal tar pitch as a binder in its products, Elkem has entered into a research collaboration with Borregaard to develop a binder based on substances from wood, i.e. a biological, green alternative. The project is supported by the Research Council of Norway and Innovation Norway.

A green alternative to coal tar pitch will have a positive impact in several ways: it will reduce PAH emissions and the employees' exposure to them, and it will reduce the industry's CO_2 footprint.

Product on the market

One important area of use for coal tar pitch is as a binder in ramming paste used as a lining material in smelting furnaces. This lining enables furnaces to withstand temperatures of up to 2,000 degrees Celsius. The ramming paste is baked rock hard on the inside of the furnace at a high temperature and normally has a useful life of 6-7 years. This means that it will take a long time to test the product.

However, Elkem Carbon has already marketed and introduced its first product based on a green binder, ELSEAL® Type G, for use in the aluminium industry. An increasing number of customers want to use the new product, which has a number of advantages compared with traditional products based on coal tar pitch. Some of the advantages:

- Contains no PAHs or other hazardous substances.
- Does not require the use of protective masks during installation.
- Produces no hazardous waste
- Is easier to handle.

ELKEM CARBON

Broad Based Black Economic Empowerment

As part of the South African equal opportunities policy, which aims to rectify historic inequalities for disadvantaged ethnic groups, the government has implemented laws that govern how companies should contribute to redress these disparities.

Each company has a scorecard that rates their impact on the Broad Based Black Economic Empowerment (BBBEE) policies. These include:

- Ownership
- Management control
- Employment equality
- Skills development
- Preferential procurement
- Enterprise development
- Socio-economic development initiatives

Elkem's policies

In order to deliver excellent results on BBBEE Elkem Carbon Ferroveld, in conjunction with co-owner Samancor Chrome, has implemented policies in the following areas:

1. Employment equity through appointing people in line with a strategy of preferential employment of previously disadvantaged ethnic groups.
2. Skills development through continuous training of employees and offering scholarships and training for community members.
3. Preferential procurement through awarding contracts to black owned companies as well as developing black owned businesses.
4. Socio economic development through working with the community to improve the lives of community members within the communities that the company operate.

The following projects have been undertaken:

- A school kitchen has been built for the Jeremiah Ndaka Primary School. The school is situated within 5 kilometres of the plant and offers schooling to 1,450 pupils. The South African government gives allowances to schools in disadvantaged communities that allows the schools to provide a cooked meal to each child every day. This kitchen will improve the quality and hygiene of the meals provided to the children.
- Elkem Ferroveld has contributed to the furnishing and medical equipment of a primary health clinic that will allow all members of the community access to primary health care. The health services offered include dental, optical as well as general medical services.

The Broad Based Black Economic Empowerment Act (53/2003): Codes of Good Practice on Black Economic Empowerment was adopted on 9 February 2007. It replaced earlier editions of the act.

ELKEM CARBON

Lower PAH emissions

Today Elkem Carbon's products contain PAHs and the company is systematically working to reduce its PAH emissions. By developing products that do not contain PAHs, Elkem Carbon wants to minimise PAH emissions both from its own production and from its customers' production.

You can read more about Elkem Carbon's development of products that do not contain PAHs in the article 'A green alternative'. Read more on page 46.

Reduction of PAH emissions to air

Elkem Carbon's PAH emissions to air have been heavily reduced. Elkem Carbon Fiskaa's goal is to lie below 50% of its permitted emissions, even with higher production. Elkem Carbon is systemically combating dust, with good results. This has an impact on Elkem Carbon's PAH emissions to air. A stable production process in a well maintained facility is also required to avoid unnecessary PAH emissions.

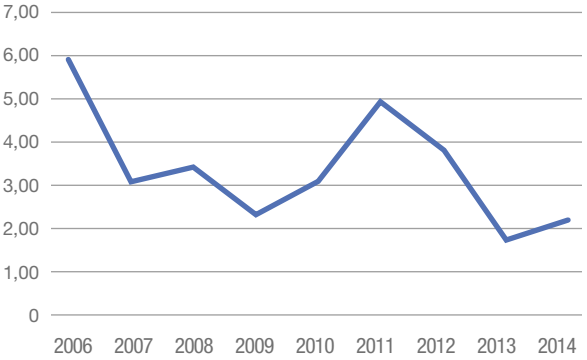
Reduction of PAH emissions to water

Elkem Carbon Fiskaa's PAH emissions to water were heavily reduced from around 650 kg to around 10 kg per year. Work is being done on various emission reducing measures. Separating water streams of clean cooling water and contaminated water, in order to be able to purify the water, is one of many measures. Extensive maintenance has been carried out on the water pipes to avoid leaks. Work is being carried out at all the plants to reduce the amount of water consumed in production.

In tropical regions, biological scrubbing methods can be used to remove PAHs and other contamination from rain water and other storm water. At Elkem Carbon's plant in Brazil water is scrubbed by being fed through three basins: one containing old trees, one containing plants, and one containing bacteria. This scrubbing method will also be adopted at Elkem's new plant in Malaysia.

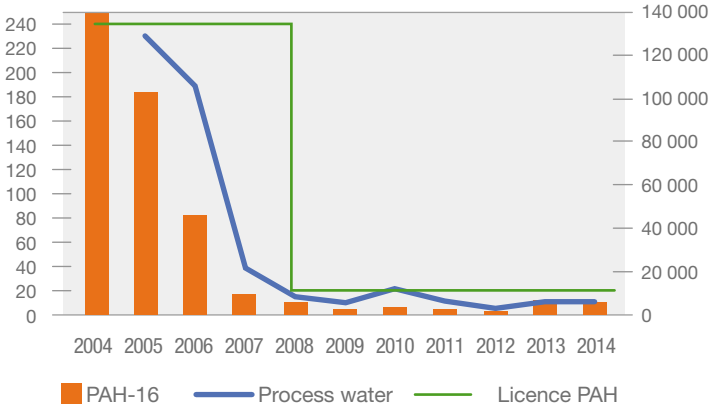
PAH EMISSIONS TO AIR, ELKEM CARBON FISKAA

Gram/tonne of finished product



PAH EMISSIONS IN PROCESS WATER, ELKEM CARBON FISKAA

Kg PAH 16/year — m³/year



Elkem Carbon's plants

Elkem Carbon, Norway

Established	1904
No. of employees	73 employees, 5 apprentices
Produces	Electrically calcined anthracite, Söderberg electrode paste, carburisers (Elgraph), ramming paste
Certifications	ISO 9001:2000, ISO 14001

Elkem Carbon, China

Established	Elkem started production at the plant in May 2000
No. of employees	107 employees, 3 apprentices
Produces	Electrically calcined anthracite, Söderberg electrode paste, ramming paste
Certifications	ISO9001:2000, OHSAS 18000

Elkem Carboindustrial, Brazil

Established	1976
No. of employees	94 employees, 2 apprentices
Produces	Electrically calcined anthracite, Söderberg electrode paste, electrodes, ramming paste
Certifications	ISO 9001:2000, ISO 14001, ISO 18000

Elkem Carboderivados, Brazil

Established	1976
No. of employees	40 employees, 1 apprentices
Produces	Pitch and other raw materials for the production of electrode paste and ramming paste
Certifications	ISO 9001:2000, ISO 14001, ISO 18000

Elkem Ferroveld, South Africa – joint venture

Established	1974
No. of employees	70
Produces	Electrically calcined anthracite, Söderberg electrode paste
Joint venture	Elkem and Samancor Chrome

Elkem Carbon, Malaysia

Elkem Carbon Malaysia is under construction and is expected to be commissioned during 2015. The plant had 6 employees at the end of the first quarter of 2015.

Elkem Carbon products

Anthracite and electrically calcined anthracite

Anthracite, which is the purest form of coal, is found naturally in coal mines and has a carbon content of 92-98 per cent. Thermally treating solid raw materials, also called calcination, turns the anthracite into an electroconductive, pure and resistant materials. This is called electrically calcined anthracite.

Pitch

Coal tar pitch is used as a binder in various carbon materials, including ramming paste and electrode paste. Tar is the raw material used to produce pitch. Tar itself is a by-product of metallurgical coke production, which is used in furnaces for the production of iron.

Electrode paste

Electrode paste consists of calcined anthracite and pitch, and is supplied as briquettes, blocks or finished cylinder-shaped electrodes. Smelting plants need electrodes because they conduct electricity and help provide sufficient heat energy to the smelting furnaces. Electrodes are also needed where production is based on smelting electrolysis, which is a chemical process created using electricity, with the production of aluminium being a prime example.

Ramming paste

Ramming paste seals joints and prevents the furnace from being damaged by molten metal. The paste is installed by ramming, i.e. using vibration and pressure. The paste is then 'baked' in connection with the furnace's start-up process.

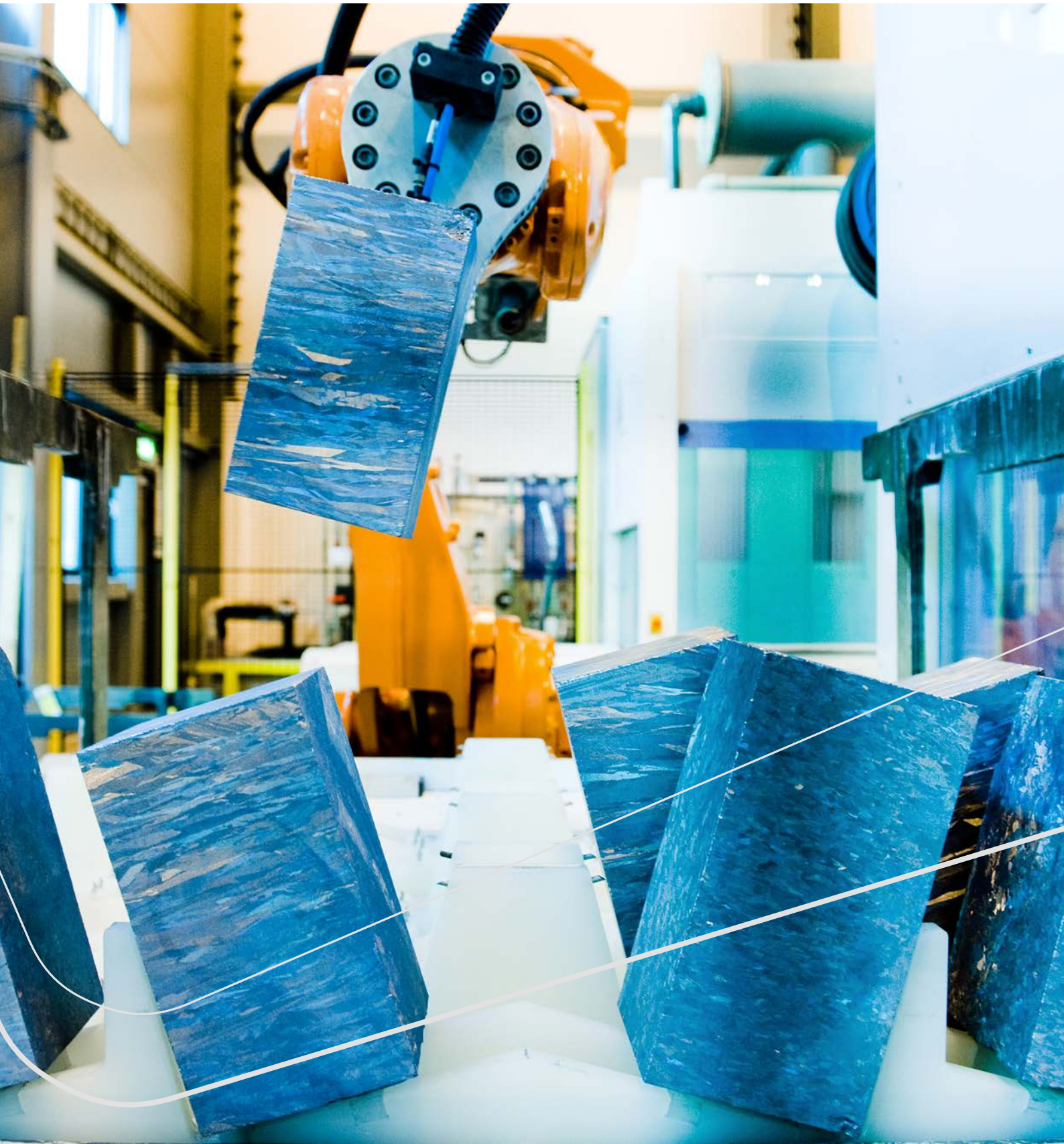
Calcined anthracite and pitch are the main components of ramming paste. Elkem Carbon's products are developed to provide the best possible work environment and are so-called cold ramming pastes, which are installed at room temperature. The exposure to PAHs from the binder is thus minimal. Elkem Carbon is systematically working on developing new and more environmentally friendly solutions, and also offers products with alternative binders that do not contain PAHs.

Carburisers

Manufacturing products in iron foundries using electric furnaces and scrap iron as the raw material requires the addition of carbon material. These are called carburisers. The further development of technical solutions at Elkem Carbon's plant in Kristiansand means that Elkem produces Elgraph®, which is a very high quality carburiser. Elgraph® has a low sulphur, nitrogen and volatile organic compounds content, and satisfies the increasingly strict requirements to such products from iron foundries and steel manufacturers.

Elkem Solar

Elkem Solar has developed and industrialised proprietary breakthrough production technology for solar grade silicon that consumes 75 per cent less energy than traditional methods. Elkem Solar is a joint venture where 50 per cent is owned by Elkem and 50 per cent by the Guangyu International Investment Company.



ELKEM SOLAR

Elkem expands its solar venture

Elkem and Bluestar's solar energy strategy is now following two main tracks: optimising production at the plant in Kristiansand and repositioning the business through the acquisition of REC Solar.

The production of ESS® represents the world's most energy efficient production of solar grade silicon, with energy consumption that is one quarter of the traditional Siemens process. With hydroelectric power as its source of electricity, no one can beat Elkem Solar's climate footprint.

In 2014, Elkem Solar in Kristiansand increased its production to its full capacity of 6,000 tonnes per year. The plan is to expand to 7,500 tonnes per year.

The process in Elkem Solar will then be further optimised and simplified. The two final production steps will lower costs by a further 40 per cent. The work will be done in collaboration with REC Solar in Singapore. This will be revolutionary compared with traditional processes and the production of new ESS® will consume about 11 KWh per kg compared with between 60 and 120 KWh per kg for competitors' polysilicon.

Acquisition of REC Solar

Elkem AS' owners, Bluestar Elkem Investment HK, acquired REC Solar in May 2015. Since Elkem Solar AS is 50 per cent owned by Elkem AS and 50 per cent owned by Guangyu International, which is not part of the Bluestar Group, it will not be possible to merge Elkem Solar and REC Solar into a single legal entity immediately. However, all of the parties agree on optimising the production process from quartz to finished solar cell panels with the aim of producing the world's most cost and energy efficient solar cell panels.

Strong market growth

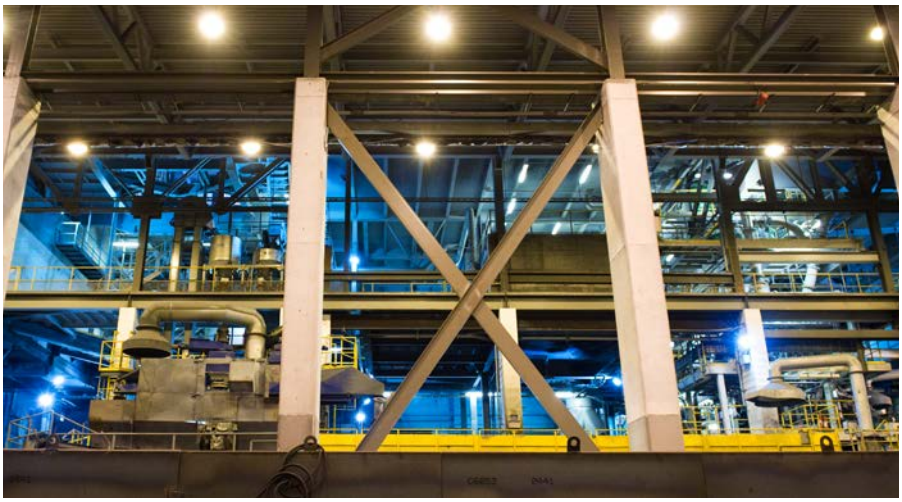
The market for solar energy continues to grow rapidly. The average rate of growth from 2003 to 2014 was no less than 50 per cent. New output of 45 GWh solar energy was installed on a global basis in 2014.

China is becoming the country with the largest total solar energy capacity. China, the US and Japan account for 55 per cent of demand. Germany has the largest installed capacity in the EU.

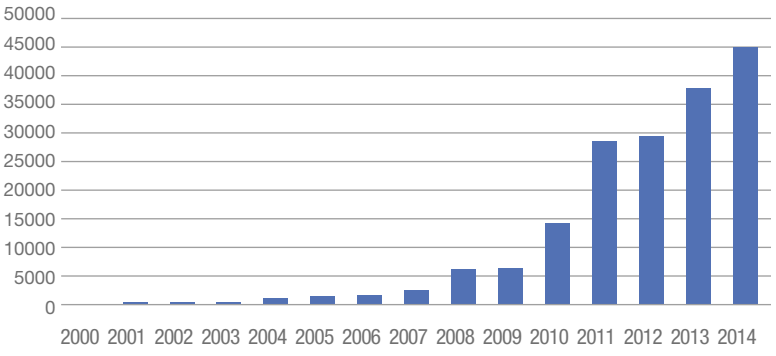
Here, solar energy has turned the energy market upside down: while prices used to rise strongly in the morning, when everyone was showering and turning on their coffee makers, prices now drop because the sun rises.

Focus on costs

Elkem Solar has experienced dramatic fluctuations in prices for solar grade silicon. In January 2012 the market price was around USD 32 per kg, a year later the market price had halved. Prices are currently fluctuating around USD 20 per kg. Focusing on costs is vital to surviving in the industry. By integrating Elkem Solar downstream with REC Solar the entire produced volume of ESS® will always have a buyer, even if the market for solar determines the prices.



INSTALLED SOLAR CAPACITY GLOBALLY per year in GW



Source graphic: SolarBuzz, IHS and Elkem

Elkem Solar, Norway

Established	2001
Joint venture	Elkem and Guangyu International Investment Company (50/50)
Produces	Silicon for the solar cell industry
No. of employees	187

Managing all transport in and out of the company

Elkem has chosen a logistics model in which the company itself manages all transport of goods into the company's production units, between the company's plants and out to customers. This general rule ensures Elkem a high level of predictability and allows the company to better manage and influence environmental and safety factors through the supply chain.

Logistics form an integral part of maintaining control over the total flow of goods, from raw materials ordered to delivery of the finished product to the customer. Many companies order their raw materials delivered, free of charge, to the factory gates and let customers pick up the products once they are finished.

Stipulates environmental and EHS criteria

Elkem instead, as a general rule, chooses to manage this part of the logistics itself. This allows Elkem to stipulate clear health, safety and environmental criteria for ships, vehicles and other means of transport that provide transport services, as well as to ensure the best possible flow of goods in and out of the plants. Drivers and crews must have the skills and knowledge necessary to satisfy all safety requirements. Elkem's corporate social responsibility policy is appended to all transport contracts and it always asks for the logistics provider's own corporate social responsibility policy.

Can refuse loading

One example of what this entails is that Elkem has introduced a 'safe truck initiative', which means that if there is reason to doubt whether a truck and/or driver satisfy national safety requirements, loading shall be refused. Drivers must be able to make themselves understood at the plants and English is a minimum requirement at Norwegian plants.

If any incongruity is not remedied, it is regarded as a breach of contract and the provider may lose its contract.

Challenges

As of 1 January 2015, new sulphur emission requirements were introduced in parts of Europe, within SECA (Sulphur Emission Control Area). In 2014, Elkem signed freight contracts for 1 million Mt of seagoing cargo for a period of between three and five years for transport wholly or partly within this area. We are facing a period of great uncertainty in the market with respect to what effect these requirements will have on shipping companies' costs. Elkem's long-term approach in this period will help the shipping companies to position themselves so they can comply with the new requirements while we ensure the best possible cargo rates in this period of uncertainty.

Complex supply chain

Elkem currently operates 14 plants on all continents and has two plants under construction. Elkem supplies more than 300 different types of products that have to be picked up and/or delivered to more than 700 destinations worldwide. This generates a significant amount of transport and complex supply chains. In Norway alone, about 2 million tonnes of products are transported to and from the plants along the coast. Up to 1 million tonnes of quartz are transported to company and non-company smelting plants from the quartz mine in Tana alone.

90 per cent by ship

Elkem uses most means of transport to get its products safely and efficiently to their destinations on time. More than 90 per cent is transported by ship for both cost and environmental reasons. The overall global picture per year looks like this (does not include all transport internally in China, Brazil or South Africa):

- About 2 million tonnes bulk by ship
- About 30,000 containers by ship
- More than 10,000 other types of transport job (vehicles, trains, barges/canal boats).

110 years of innovation

Elkem's history starts in 1904 when industry entrepreneur Sam Eide (1866–1940) established the company. The goal was to become a major industrial company with a global outlook based on Norwegian natural resources, hydropower and know-how.

1904: Elkem is founded by Sam Eyde, brothers Magnus and Knut Wallenberg and Knut Tillberg.

1919: 51 different companies belong to the Elkem sphere, including Norsk Hydro (later Yara), Kristiansand Nikkelraffineringsverk (later Xstrata).

1917: Elkem patents the Söderberg electrode, which is still in use in about 75 per cent of the world's smelting plants today.

1920s and 1930s: The Great Depression: almost all of Elkem's companies are sold.

1958: Elkem becomes an aluminium producer.

1963: Elkem joins forces with Alcoa as a partner.

1965: Elkem helps to found Norway's first oil company, NOCO.

1972: Elkem merges with Christiania Spikerverk, becomes Norway's largest industrial company and helps to found Saga.

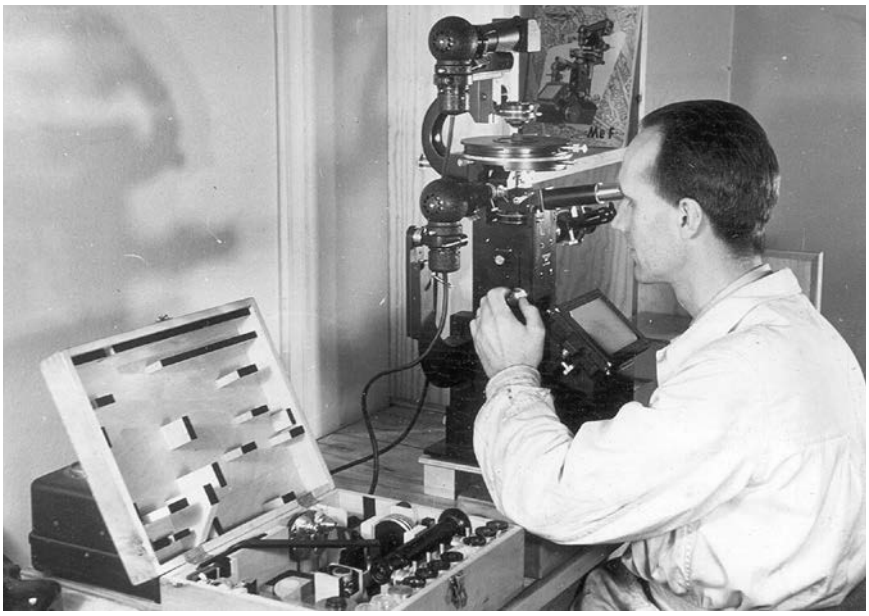
1980: Elkem buys seven ferrosilicon plants in Norway, the US and Canada, and becomes the world's largest producer of ferroalloys.

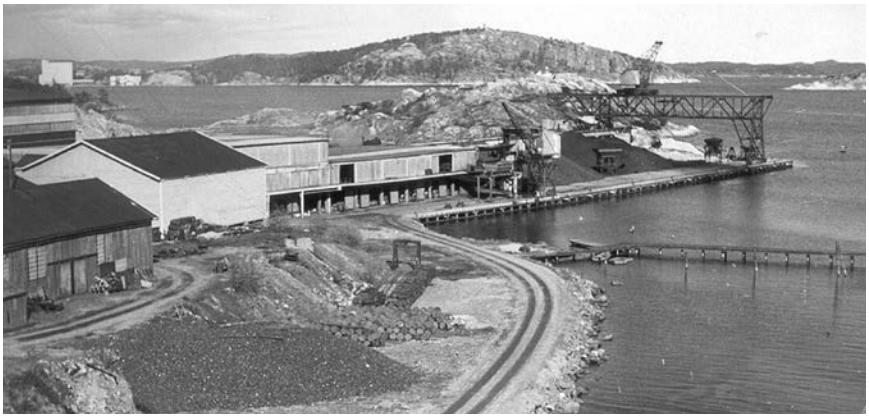
2005: Elkem takes over aluminium profiles company, Sapa, which employs around 14,000 people. Elkem owns 23 per cent of REC.

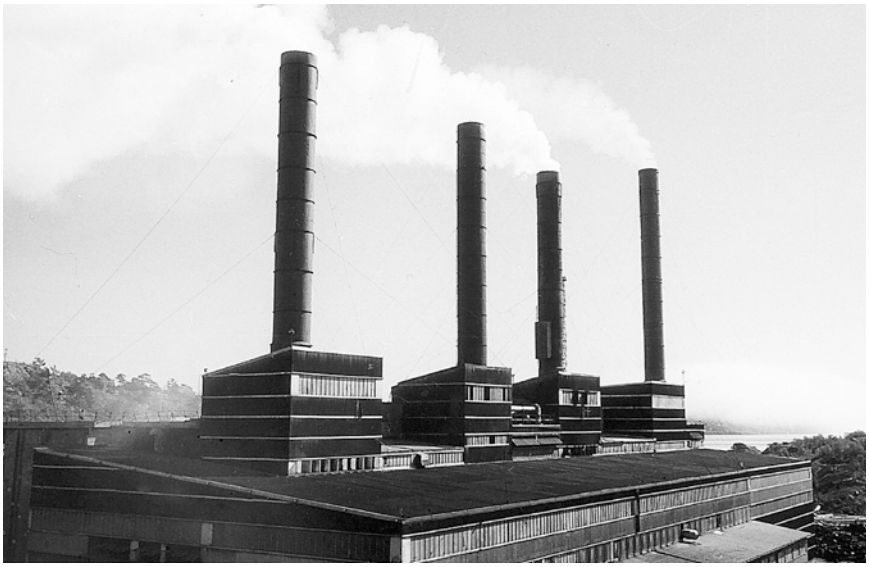
2005: Orkla acquires Elkem.

2009: Elkem ceases its aluminium production. Alcoa takes over the plants.

2011: China National Bluestar buys Elkem from Orkla.







Our license to operate

Elkem has clear ambitions for growth. Our vision is to expand our business as part of an industry with zero emission, zero injuries and no waste of resources or energy. In other words a 100 per cent recycled economy, creating values without harm to anyone.

Some might say that this is a utopian idea. My belief is that it is the only way to secure our license to operate in the future. This is the philosophy behind the resources we put into R&D, our focus on continuous improvements and our investments in new equipment.

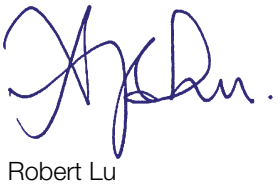
Let me illustrate this: We have installed energy recovery systems at five of our plants, and the strategy is to install this at all our plants. In the short run, low energy prices may make such investments expensive, if not to say unprofitable. In a broader perspective it is very clear to me that we cannot afford to waste energy.

Elkem's owner, Bluestar, turned 30 years in 2014. Our founder, Ren Jianxin, established China's first professional industrial cleaning company – the Bluestar Co. – in 1984, along with seven people and a 10,000-yuan loan. Since then, Bluestar has gradually grown into being one of China's most successful chemical companies. Bluestar is centered on the chemical industry, new chemical materials and animal nutrition. Bluestar is also a global investor in new business. A key to Bluestar's success has been to integrate the Bluestar companies in order to optimize production processes. Also important is Bluestar's focus on bringing professional management from different parts of the world together, in order for them to learn best practice from each other.

One example of such integration is Bluelco, a project that aims to optimise the entire silicone value chain, from the extraction of quartz in the mine in Tana, Norway, through the production of silicon (Si99) at the Elkem plant in Salten, Norway, to the production of specialised silicone at Bluestar Silicones International in France. This project has been a great success, contributing to more than 20 million Euros in savings. The next step will be the formal integration of the French and Norwegian entities.

Making electricity from the sun makes it possible to bring people the obvious benefits of electricity without the environmental disadvantages connected to power plants running on coal, oil or even gas. After having bought REC Solar our aim is to make this production process even more efficient and sustainable. The fact that our Norwegian plant runs on hydro energy, gives our solar panels a huge climate advantage. I hope that we will be able to expand our production both in and outside Norway, bringing clean electricity to people all over the world.

Elkem's vision is to reduce the number of work place injuries to zero. I am proud to observe that our Bluestar plants in China, Yongdeng and Xinghuo, have also made important progress in this regard. The number of total recordable injuries at the two plants with 109 employees, fell from 20 in 2013 to 14 in 2014.



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