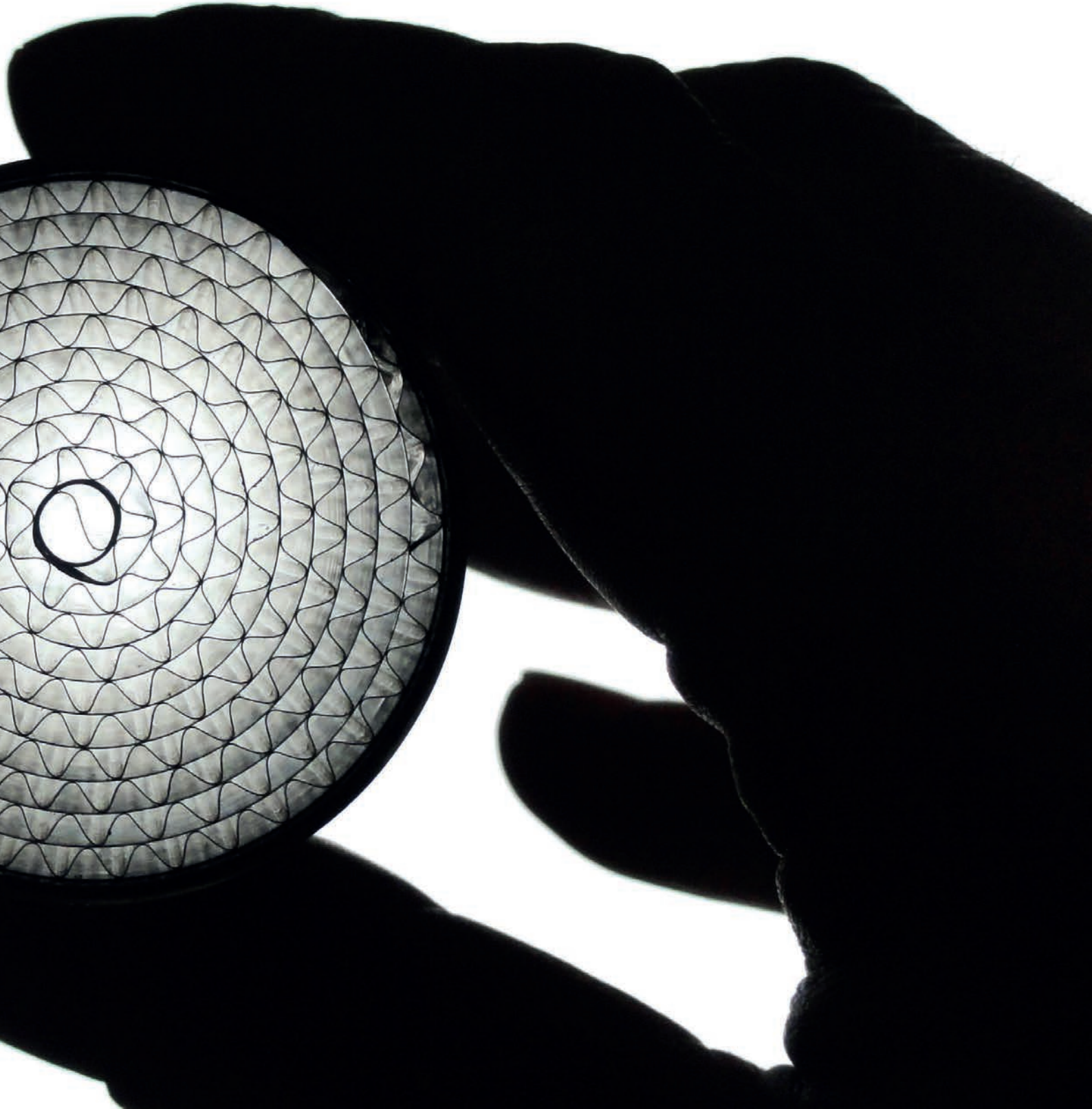
National action for metallic materials

A STRATEGIC RESEARCH AND INNOVATION AGENDA



Nationell samling kring metalliska material
EN STRATEGISK FORSKNINGS- OCH INNOVATIONSAGENDA
2013

The Swedish metals-producing Industry's associations:
The Swedish Steel Producers' Association (Jernkontoret)
Swedish Aluminium
Swedish Foundry Association

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Summary

For the first time ever, the Swedish metal industry has developed a common, strategic agenda for research and innovation. Its objective is to enable the industry to prosper from opportunities identified in the global market.

The strategy takes its basis in the well established industry strategy to identify and explore strategic market niches, while aiming at exploring the rising demands for sustainable solutions in key areas such as transportation, energy exploration and generation, construction, and selected metalworking and manufacturing markets.

The development efforts are aimed at developing and improving business models to better explore and develop new customer values, working the value chain to understand its key challenges and opportunities, increase the speed and precision in materials development, improve flexibility to better meet rapidly changing business conditions, improve resource efficiency, reduce environmental impact and increase attractiveness to new and develop existing talent.

The vision is that Swedish metal industry is a well known and important enabler as society strives for a better future. This means its customer offers are on the leading edge technologically, economically and environmentally, and are developed by competent, motivated and innovative people. At the same time, the industry's environmental footprint is the smallest possible.

Sammanfattning

För första gången någonsin har den samlade svenska metallindustrin utvecklat en gemensam, strategisk forsknings- och innovationsagenda. Målet är att göra det möjligt för industrin att utnyttja de möjligheter som identifierats på den globala marknaden.

Strategin baserar sig på industrins långa erfarenhet av att identifiera och etablera strategiska nischmarknader och syftar till att skapa tillväxt genom att möta de växande kraven på hållbara lösningar inom nyckelbranscher som transport, energiutvinning och -generering, byggnation, och utvalda marknader inom tillverkningsindustrin.

De föreslagna insatserna riktar sig mot nya och förbättrade affärsmodeller för att öka intjäningen från existerande och utveckla nya kundvärden, involvera hela värdekedjan för att bättre förstå dess begränsningar och möjligheter, öka farten i materialutvecklingen, öka flexibiliteten för att kunna möta det mycket föränderliga landskap i vilket industrin verkar, öka resurseffektiviteten, minska miljöbelastningen och sist men inte minst öka attraktiviteten för nya medarbetare och utveckla de befintliga.

Den vision som agendan strävar att förverkliga är att svensk metallindustri ska vara en väl känd och viktig möjliggörare i världens strävan att forma en bättre framtid. Det innebär att dess erbjudanden till kund ligger i den absoluta tekniska, ekonomiska och miljömässiga framkanten och utvecklas av drivna, engagerade och innovativa människor. Samtidigt har tillverkningsmetoderna ett så litet miljömässigt fotavtryck som det bara är möjligt.

Introduction

The metals-producing industry – hereafter denoted “the metal industry” – is a central and growing part of the Swedish economy. The changing conditions caused by globalisation are likely to increase its importance. This document is a strategic agenda for development and renewal in the area of metallic materials. For the first time ever, the Swedish metal industry unites its resources in a common research and innovation effort.

An exciting future

The recent expansion of democratic rights and free trade around the world has led to rapidly improving living conditions for a greater part of the world’s population. Until a few years ago, this growth seemed unstoppable. However, within a short period of time, the world has seen two financial crises, the first in the private sector and shortly afterwards a fiscal one. This has shown that the growth was not entirely based on real factors, but also on the spending of future financial assets. In conjunction with this, there is growing concern that the world in a similar fashion ”overspends” its natural resources and that this will lead to environmental and climate crises in the future.
Considering the current chaotic situation, predicting the future is all but easy. Despite this, the Swedish metal industry sees a future scenario with many opportunities.

Global niche offerings

”In this scenario, advanced metals solutions are offered globally, while bulk products are produced locally...”

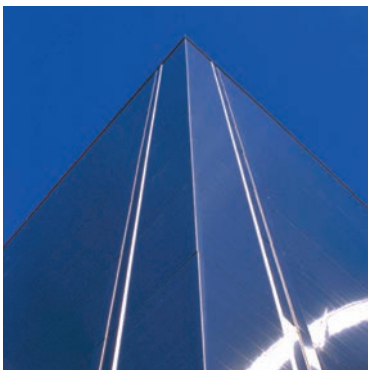
In this scenario, advanced metals solutions are offered globally, while bulk products are produced locally to avoid high transportation cost. This can be seen as a parallel to the construction sector, where homes often are built from local materials, whereas the more sophisticated systems, e.g. for energy and communication, are provided by global suppliers. In such a world, the Swedish metal industry has a superb position, considering our long tradition of niche offerings with advanced materials and value-added solutions, our local access to raw materials and energy, and our truly global industry which is well represented throughout the world.

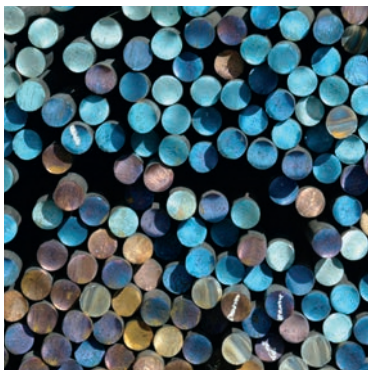
The opposite scenario is of course also thinkable, one in which economies of scale is the key to success and a few gigantic mills provide the world with off-the-shelf products at low prices. Local modifications and adaptations are made by local specialists. However, such expectations have earlier failed to materialise. When the car industry went global in the 1970’s and 1980’s, GM, Ford, Fiat and Toyota were expected to rule the world. However, niche makers such as Porsche and BMW have shown the by far most stable development and profitability, whereas the major producers, almost without exception, have been facing difficulties.

When it comes to metallic materials, there are additional reasons to discard the economies of scale scenario, namely that it assumes firstly stable and predictable global prices for raw material and energy, secondly slowly increasing demands for improved products, and thirdly low cost transportation. Today only the last of these conditions apply, and even that stands on shaky ground.

The measures identified in this agenda would give the Swedish metal industry power to promote the first scenario, thus bringing growth and welfare to the Swedish metal industry and hence to Sweden.

Vision and objectives





The agenda's vision

The Swedish metals producing industry will be a key player in the world's quest to shape a better future. This means that its customer offerings will be at the technical, economic and environmental leading edge and be developed by driven, dedicated and innovative people, at the same time as the manufacturing processes will have minimum environmental consequence.

"...at the technical, economic and environmental leading edge..."

Seven steps towards renewal, growth and increased competitiveness

To achieve the vision this agenda sets out seven key steps:

1. Develop market offerings

2. Open up the value chain

3. Accelerate materials development

4. Increase flexibility

5. Improve resource efficiency

6. Reduce environmental consequences

7. Boost industrial competence and appeal

SWOT

Strengths

- Effective development of advanced high-performance metallic materials combined with modern applications insight
- Sustainable technology and products, including service concepts
- Global presence
- High-quality Swedish raw materials and CO2-free electricity
- Well –developed niche strategy
- Strong and established collaboration in the knowledge triangle
- High degree of environmental awareness

Weaknesses

- Distant to growth markets
- High costs
- Weak appeal to young talent
- Strong dependence on established products
- Failure to exploit the full potential of the business offer
- Many small component manufacturers have difficulty in supplying to major OEMs
- Dependence on imported fossil raw materials and fuel

Opportunities

- Increased global demand for resource and energy efficiency
- Increased global demand for innovative solutions for improved sustainability
- Increased competition in customer segments leads to increased demand for niche solutions which boost customer competitiveness
- Flexible use of raw materials and energy provides cost benefits

Threats

- Fluctuations in prices of raw materials and energy with time and location
- Niche solutions are copied more rapidly
- Focus on the economies of scale reduces the scope for specialisation
- Surcharges and conditions which are not competitor-neutral

Manufacturing methods

Steel

Steel is mainly produced in two ways:

- by melting the steel and iron scrap to make new steel or
- by refining iron ore into pig iron and then decarburizing this to give steel.

Even in the latter process, significant amounts of steel and iron scrap are used.

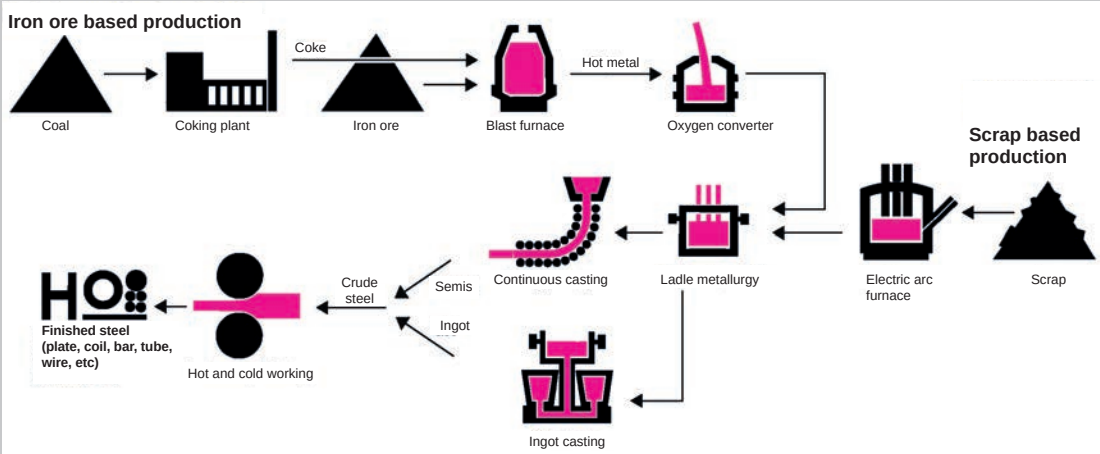
Refining iron ore is mainly done in the blast furnace process, in which carbon is added to reduce the oxide in the iron ore to metallic iron. The oxygen released from the ore forms carbon monoxide and carbon dioxide. There are also so-called direct reduction processes. These may be based on coal or natural gas. In both processes, carbon monoxide is used is used to reduce the ore, in the latter case also hydrogen gas.

Approximately 450 million tonnes of the world steel production is from remelting scrap. This amount has been increasing year by year for decades, as the supply of scrap has increased. However, the relative proportion has decreased from about 34% ten years ago to below 30% today, due the rapid growth in steel use in the 21st century.

Exactly how much of the steel used in society is recycled is difficult to quantify, because the life of the steel products is difficult to predict. However, for products with relatively short circulation time, such as cars, it has been shown that the recycling rate is close to 100%. A recent study showed that in Germany, each iron atom was reused on average six times in a century.

Sweden has three blast furnaces in operation, one at SSAB's steel mill in Luleå and two smaller ones at the company's site in Oxelösund. Höganäs uses a direct reduction process to produce so-called iron sponge, which is in turn used to produce iron powder. All other steel manufacture in Sweden is based on scrap.

During the production of steel, a range of other products such as slag, scale and dust are formed. After recovery of the metal content, slag is used in many different ways, e.g. as a raw materials in steel production, ballast in road construction and filler. Examples of other residues are tar, benzene, sulphur, mill scale and pure iron oxide from acid recovery. Most of these are sold externally and become raw materials in other manufacturing processes.



Aluminium

Like steel, there are two main ways to produce aluminium. Primary aluminium is produced by extraction from bauxite which is refined into alumina. An electrolysis process is then used to reduce the oxide to pure aluminium. Secondary aluminium is produced by remelting of scrap and other aluminium products. Secondary aluminium is divided into two subgroups, remelted and recycled. Remelted is mostly process scrap, while recycled aluminium is from discarded products.

In Sweden, there is one producer of primary aluminium, Kubal in Sundsvall, and one recycler, Stena Aluminium in Älmhult.

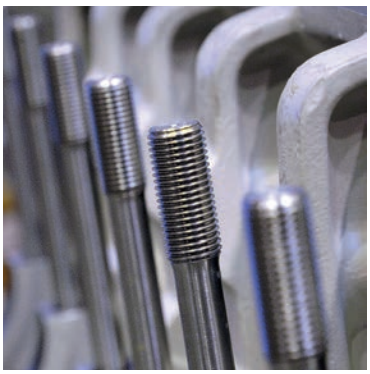
Component casting of steel, ferrous and non-ferrous metals

The materials that are most commonly used in component casting are cast iron, cast steel, aluminium, magnesium, zinc, and copper-based materials.

Generally, the raw materials are from components which are recycled, but virgin metal is also used. The energy source for the melting process may be electricity, coke or gas.

Sweden has a strong foundry industry with 170 component foundries, mostly small-and medium-sized enterprises, but also larger foundries such as Metallfabriken Ljunghäll. In addition, several large global companies, such as AB Volvo, Scania CV, SKF AB and Huskvarna AB have their own custom component foundries.

Current status



Steel

The Swedish steel industry has shown a steady upward trend for several decades. In 1980 Sweden exported steel for almost 10 000 MSEK. By 2011 the figure had risen to over 56 000 MSEK. Adjusted for inflation, the developments in the last 30 years represent a growth of 2.2% per year. Since a large part of the raw materials - iron ore, steel scrap, lime and electricity - is from Sweden, this represents net exports. In addition, Swedish steel is a component in a wide range of other Swedish export products.
At the same time Sweden imported steel in 2011 for only 38 000 MSEK. The volume was almost exactly equal to the volume of exports.

World class steel production

The value differs by almost 20 000 MSEK because Sweden exports advanced steels to selected market niches, while imports consist largely of standard products. Swedish steel companies are, for example, world leaders in advanced high-strength carbon and stainless steels, tool steels, iron powder, seamless stainless steel pipe and high purity steels. These Swedish steel companies are active on the global scale and have extensive sales and service networks.

The Swedish steel industry's long tradition of successful development and production of high-end steel products has contributed to Sweden today having a strong scientific infrastructure in the area. Sweden is one of few countries in Europe that still have academic institutions covering the entire chain from mining and melting to forming and properties. Strong industrial research institutes, especially in the SWEREA Group, provide Swedish companies with access to applied research of an international calibre.

"...access to applied research of an international calibre."

Well-developed value chains

In Sweden, there are also a number of small and medium-sized companies specializing in manufacturing products that take advantage of the often unique properties of Swedish steels. There are also companies that supply products and services to the industry and its customers. Examples of such products that are exported include train interconnectors, disc brakes, cranes, salvage units, shafts and a range of other applications where lighter products can be used to increase the payload. In Sweden there are also examples of the leading manufacturers of equipment, such as roll forming and hydro forming, which is used to process advanced materials.

For many Swedish engineering companies, steel is an important component. Approximately ten percent of the end users' purchasing costs are steel. For component manufacturers, the figure could be as high as 35%.

Steel creates employment
Production of steel in Sweden employed more than 17 000 people directly in steel companies in 2010, and about 28 000 people indirectly with various suppliers, according to Hagman & Linds employment indicator. Ten years ago, the corresponding figures were just under 20 000 and over 24 000. This means that even the total employment in the industry is increasing.

Aluminium

Sweden's aluminium industry shows some similarities but also some differences compared to the steel industry. Like steel, the aluminium industry enjoyed steady growth for several decades. Another similarity is that imports are at about the same level as domestic production, but exports are slightly smaller, because domestic use exceeds production.

In fact, the domestic use of aluminium is high even by international standards. As an example, it is significantly larger than Norway's, even though Norway by virtue of its good access to electricity is a major producer of primary aluminium, with ten times as much production as Sweden. There are a large number of Swedish aluminium foundries, also described below, but even more manufacturers of different products for which aluminium is the most important strategic material.

Sustainable high quality products
The Swedish aluminium industry is characterized by high quality products with low environmental footprint, increasingly sophisticated products and systems deliveries which extend far into the end user market. Compared to the steel industry, the centre of gravity of the aluminium industry is a bit more downstream. For example, the world's largest producer of aluminium profiles, SAPA, is based in Sweden. There are also a number of small and medium-sized foundries, especially in die casting.

The Swedish aluminium industry employs approximately 5,000 people directly. In addition, the Swedish engineering and construction industry produces a large amount of aluminium products.

Steel castings, cast iron and non-ferrous metals

"...metals are very easy to remelt and use in new products without any deterioration in quality of the new product."

Metallic materials are often cast, and Sweden has a prominent position in terms of the per capita use of castings. This is due in large part to our vehicle production - almost 70% of all castings we produce are used in vehicles. Nearly 350,000 tons of cast products are made in Sweden, but this covers less than half of the need for castings. The export value is about 13 000 MSEK. A large part of production is exported either directly or indirectly as components e.g. in vehicles. Other areas where cast components play key roles are windmills, water pumps, presses, mobile transmitters, consumer electronics, home appliances and furniture. The full list is even longer, so there is a huge potential for the Swedish foundries to expand. Global statistics show that the use of cast components is steadily increasing. In 2001, global production was 68 million tonnes, increasing to 80 million tonnes in 2009. Today it is over 100 million tonnes. The main drivers of this development are new materials with unique performance, and that metals are very easy to remelt and use in new products without any deterioration in quality of the new product.

Steadily increasing demand
Several of the largest export companies rely on cast components, AB Volvo, Scania CV, GKN Aerospace, Ericsson, Atlas Copco are just a few of these. We also have several international small-and medium-sized companies that develop complex cast components - for example Indexator and Oldsbergs Hydraulik.

The automotive industry is increasingly seeking lighter, high strength and multifunctional features, which contribute to reducing CO2 emissions and thereby climate change. Large infrastructure projects in railways, wind power and mobile telephony contributes to an increased demand for increasingly sophisticated cast products.

Knowledge – a competitive advantage
The Swedish foundry industry's biggest competitive advantage is based on the shift towards the production of more knowledge-intensive and high-tech products with high added value and low price sensitivity. Our ability to continually develop innovative products and processes is critical to our ability to maintain a technological lead in an increasingly globalized and competitive castings market. This requires large investments in competence development of existing and new personnel.

The Swedish foundry industry has about 7,000 employees in about 170 foundries. Much larger numbers work with castings in Swedish value chains.

Copper, zinc and lead

Like the iron and steel production, copper production has a long history in Sweden. Today, copper and lead production in Sweden is carried out within the Boliden Group. The Group also has an extensive production of zinc ore, but this is further processed mainly at facilities in Norway and Finland. These metals are not covered by this agenda, but are dealt with in the agenda of the mining industry.

Suppliers to the metal industry

The metal industry needs a number of raw materials and other supplies. The most important are iron ore and bauxite, scrap (from manufacturing, fabrication and recycled products), coal, limestone and other minerals, alloying additions, oil and gas for energy and electricity, and refractories. In addition, the industry buys services such as maintenance, marketing, R & D, and more. Comprehensive logistics services are also included – many semi-finished products are transported between different mills and manufacturing sites.

Several suppliers (and customers) to the steel industry participate in Jernkontoret Research as full members.

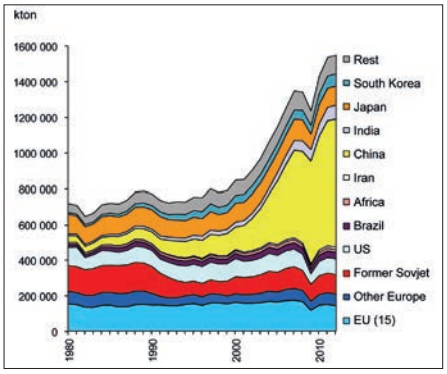
”...biggest competitive advantage is based on the shift towards the production of more knowledge-intensive and high-tech products ...”

World status

”Together, steel and aluminium make up more than 98% of the world’s metallic construction materials.”

Steel (including iron) is by far the world’s most widely used metallic construction material. Finding man-made objects which neither include steel nor have involved steel during their production is almost impossible. The world consumption of steel is about 1 500 million tonnes per year (2012). This is more than sixteen times the consumption of aluminium and other metals together.

Aluminium is in a clear second place, with about 50 million tons per year. Together, steel and aluminium make up more than 98% of the world’s metallic construction materials. The dominant construction material is cement (3 300 million tons), with steel in second place. In third place is wood at about 800 million tonnes per year. Slag from steel production, 400 million tonnes per year, is in fourth place, followed by plastics (270 million tonnes).



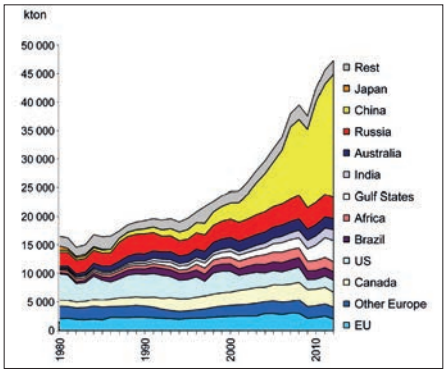


Fig. 1 (left) Crude steel production by countries and regions, 1980-2012. Source: World Steel Association
Fig. 2 (right) Primary aluminium production by countries and regions, 1980-2012. Source: EAA, AA, JAA, ABAL, RTA, Metallstatistik

Geographically, nearly half of all steel is produced in China, while Asia outside China, the U.S., plus the EU27, and the rest of the world share the rest in approximately equal parts (Figure 1). The picture for aluminium is very similar (Figure 2). About half of all steel produced is used various types of building and construction. Figure 3 shows how the steel usage is distributed across sectors.

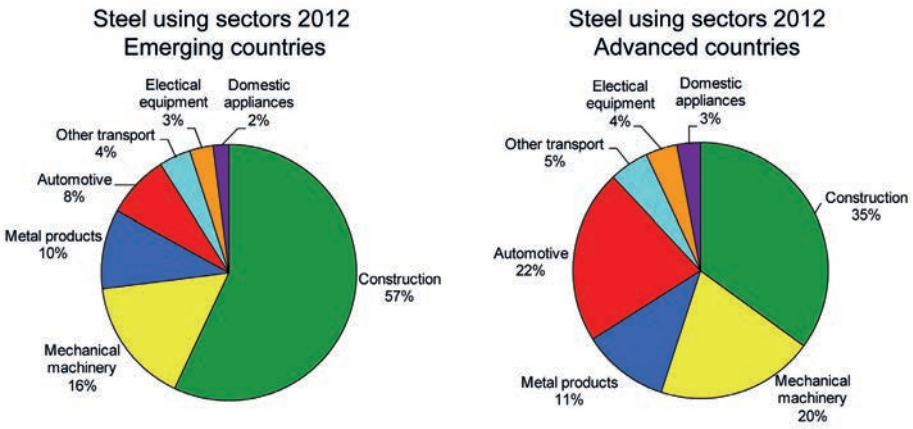
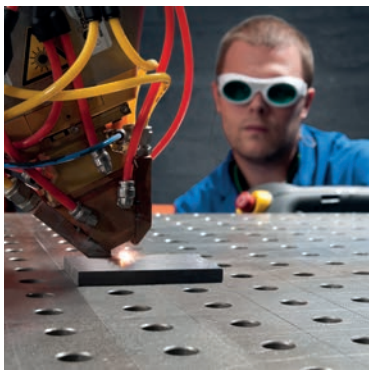
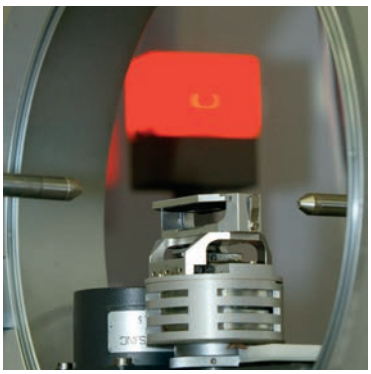


Fig. 3: The distribution of steel use across sectors. Source: Worldsteel Association

The future





Steel

Globally, steel as a construction material will continue to grow for the foreseeable future. Since all countries have exhibited a very similar pattern of use of steel – at a per capita GDP of approximately 5 000 USD steel consumption rises rapidly, then flattens out at 15 000 USD per capita and decreases slightly after that (Figure 5) – it is possible to predict future global demand for steel with the same precision as economic development. The same pattern also applies to aluminium.

New production methods

An analysis of the various published estimates[1], which in turn are based on different scenarios for costs and limitations of CO2 emissions, predicts that steel requirements will increase to 2050. The need for new raw iron will, however, peak around 2030 and return to current levels by 2050. Around 2090 it is expected that almost all of the world's need for new steel will be met through re-melting of scrap.

1. "Global Technology Roadmap for CCS in industry, Steel Sectorial Report". J-P Birat et al.

"Around 2090 it is expected that almost all of the world's need for new steel will be met through re-melting of scrap."

An increasing share of steel production from ore is expected to be via direct reduction. This is partly because the method has CO2 benefits and can make use of natural gas. As a result of large, newly discovered deposits the price of gas has dropped in recent years, while that of coking coal, used in the blast furnace process, is expected to rise.

New markets

At some time between 2025 and 2030, the world's steel consumption is predicted to exceed 2000 million tonnes (Figure 4). The construction sector is expected to increase its share. In particular, India and the populous countries in Africa are expected to contribute to the increase as the standard of living in these countries now approaches the level at which steel use increases substantially.

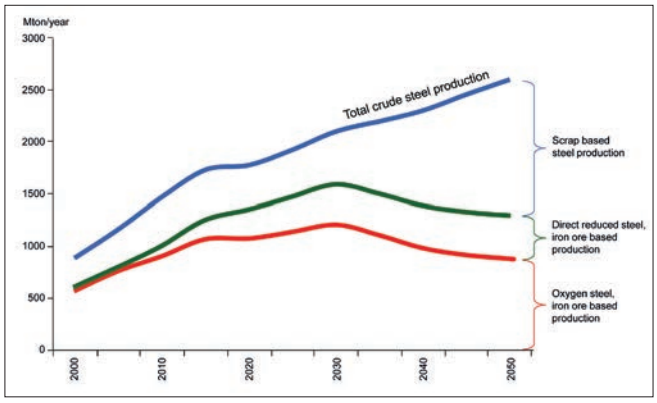


Fig. 4 Global crude steel production by technology. Source: Global Technology Roadmap for CCS in Industry, Steel Sectoral Report", J.-P. Birat et al

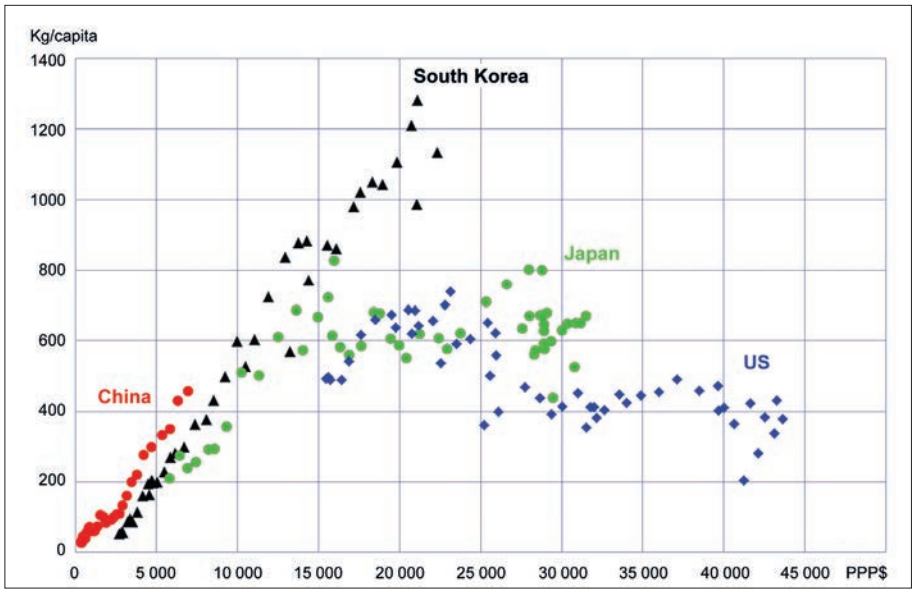


Fig. 5 Steel use per capita vs GDP per capita in different countries. Source: World Steel Association

What could possibly change the picture is the substitution of certain construction materials. Within the building and construction industry, the dominant market for steel, there is a current trend for steel to be replaced by composite materials to some extent. However, at the same time steel is replacing concrete and wood at an even faster pace. If this trend continues, therefore, the use of steel will increase a little faster than predicted.

Aluminium

Aluminium is facing a similar trend. Despite the financial crisis, the world production has doubled in the last decade, and this trend is expected to continue. The proportion of aluminium used in the transport sector is steadily increasing and the use in automotives has tripled since the 1990's. The material's low density is a key enabler for lightweight structures. The high thermal conductivity means that all heat exchangers in vehicles today are made of aluminium. The good electrical conductivity has led to the same development for high-voltage power transmission lines.

Steel castings, cast iron and non-ferrous metals

Materials such as cast steel, iron and non-ferrous materials are predicted to show a strong positive development. In 2001, the global production was 68 million tonnes, increasing to 80 million tonnes in 2009. Today it is over 100 million tonnes. This development will affect Swedish industry in a positive way. Today, about 30 000 people in Sweden work with cast products and the materials are expected to show appreciable growth in the next decades.

Future challenges provide opportunities

For Sweden, the forecasted development is expected to provide great opportunities, but also appreciable challenges.

”For Sweden, the forecasted development is expected to provide great opportunities, but also appreciable challenges.”

Oppportunities

The Swedish metal industry tailors its offerings

A niche player's mission is to tailor its offering for customers that are willing to pay for a product or service so that it goes beyond offerings from producers of standard products. This could be in the form of improved product properties or the same properties but in a different shape (longer, wider) or delivered in a different condition (quicker, further refined). It could also be collaboration regarding materials selection and application, in order to improve the customers' products and hence strengthen their competitiveness. As mentioned before, the Swedish metal industry has long experience in this area. Increasing global competition and demand for resource efficiency will increase differentiation and specialisation, which will lead to increasing opportunities for those suppliers that can adapt their offer to customer needs and thus create added value.

Resource efficiency creates advantages

Particularly the need for resource efficiency creates new opportunities. Resource efficiency means both utilising less resources with minimal impact to achieve a certain function and finding more function for a given use of resources, such as increased use of residues. Requirements of increased resource efficiency therefore provide a huge opportunity for Swedish producers of steel, aluminium, cast products and other materials created in their processes. But more importantly, it means increased opportunities for the users. The EU has set medium and long-term goals for resource efficiency in a broad sense. Players that take the lead in this conversion will have advantages in the EU as well as on a global scale. Using resources more efficiently is a prerequisite for reaching several of the EU targets, such as reduced greenhouse gas emissions. In short it will determine how we protect valuable ecological assets and safeguard quality of life for existing and coming generations.

”Players that take the lead in this conversion will have advantages in the EU as well as on a global scale.”

Improved materials determine the future

The transport sector, for instance, depends on improved materials in order to meet the demands of the future. The Economist (2010) says, referring to a study published in The Shot Peener[2], that half of the solutions for the sector lie in reduced weight, and the other half in reduced transmission losses. The success of both these approaches depends on improved materials, often steel and aluminium, sometimes combined with carbon fibre composites or advanced surface treatments. Here, Swedish achievements within advanced metallic materials could be of substantial benefit.

The buildings of the future also have to be more lightweight than today, if our cities are to be built taller and more densely on top of existing infrastructure such as subways, road tunnels and other supply systems. At the same time the need for cooling and heating should be reduced. This equation can be solved only through new materials providing innovative functions.

2. The Economist Newspaper Ltd, London, April 9, 2010, med referens till “Unbearable Lightness”, in The Shot Peener, Vol 26(1) ISSN 1069-2010 pp 6-8

The rapid urbanisation will also demand innovations in water, food, and energy supply as well as plumbing and sewage treatment. This area will offer many opportunities for commercialising improved materials for more appropriate functions.

The above mentioned areas have been identified by the EU, in its road-map to a resource efficient Europe.

Better materials are the basis for improved energy efficiency

The development of the energy sector itself is also dependent on improved materials. Better materials present possibilities to increase resource efficiency, for instance by increasing temperatures and thus efficiency in electric power generation, as well as in transmission of electric power. Improved materials are also needed to build taller and bigger wind turbines, perhaps at sea or in arctic climates, or more durable solar cells. Overall, improving energy sector efficiency is probably the single most important measure for improved resource efficiency globally. The Swedish steel industry's efforts in high-strength heat resistant stainless steels, advanced cast products and nickel base alloys already play a key role which can be further developed.

Niche offerings strengthen competitiveness

Generally, it is important that the Swedish metal industry has the courage to specialise and develop niche offerings. There is a huge potential, not least for refined cast components, and a flexible and efficient production would further strengthen competitiveness. The products are becoming more and more complex, integrating more and more functions, and time to market will continue to be increasingly important for staying ahead of competition.

Smart use of raw materials and residues provide opportunities

For obvious reasons, the demand for increased resource efficiency will also affect how metallic materials are produced. The production process itself will have to reduce its environmental footprint, and it can also contribute to other sectors reducing theirs, by sensible and innovative use of raw materials and residues.

The high demand for raw materials can also be turned into an opportunity. The producer whose processes accommodate quick conversions to those inputs that are most cost effective at a given time will have a significant cost advantage over its competitors.

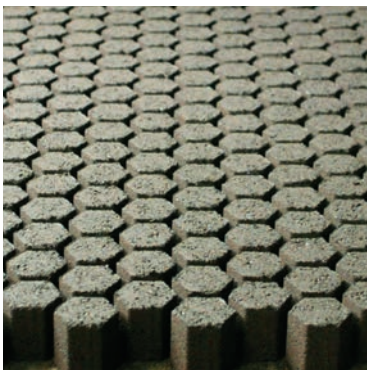
The Swedish metal industry creates a sustainable society

The fact that Sweden has a well developed industry with complete and competitive value chains and at the same time is small enough to allow close collaborations between sectors provide unique opportunities to create innovative, resource efficient ways to achieve new and complex functions. There are distinct opportunities for development and growth here. A constantly increasing competence based on firm and excellent research also provides a basis for international collaboration.

”... unique opportunities to create innovative, resource efficient ways to achieve new and complex functions.”

Revenue can be generated not only from selling functions per se, but also through the knowledge on how to achieve them. The research and methodology development regarding anything from low-CO2 production of raw iron to lightweight design of resource efficient products could become important export items, and also strengthen Sweden by attracting foreign companies and researchers. In short, the Swedish metal industry could position itself as a “cleantech enabler” – a driver for qualified solutions for a sustainable society.

Challenges



Stay ahead

A major challenge for the metal industry is the global map's significant changes over the past ten years. As a result of developments in the world's emerging economies, the global center of gravity for the production and use of steel and other metallic materials has moved to Asia. This trend is likely to continue and it is, for example, reasonable to assume that at least half of all passenger cars in the world will be produced in China within 20 years. Such a market development places major demands on the Swedish metal industry as a global supplier. Not least the great distance from the emerging markets is a challenge.

This means that the industry must continue to develop their market niches. It may seem an exaggeration to say that the Swedish steel industry is changing the world. Nevertheless, there is a long list of examples where the Swedish steel industry has introduced advanced products that have become standard for a particular application. As soon as this occurs, it of course reduces the scope for customized niche offerings in the respective segment. The rapid expansion of the industry has also lead to an increasing number of competitors with modern facilities and the capacity to produce advanced materials. This means that investments in both new technologies and new knowledge are needed in order to maintain a position at the technological forefront.

"...investments in both new technologies and new knowledge are needed in order to maintain a position at the technological forefront."

Assist customer choices

A general challenge in the commercialization of new materials is that a new material always involves difficult trade-offs for users, even if the benefits of using the new material are obvious. This is because the user's infrastructure is by definition designed for existing materials, so new materials typically require investment in new equipment and new skills.

Use the potential of residues

In Sweden, there are also a number of challenges in the use of industrial residual products. Attempts to reduce waste, increase reuse and recycling by utilizing slag have met with great scepticism. This means that Sweden uses much smaller amounts of the slag produced by the steel industry than other countries, even within the EU.

Ensure competence availability and industrial appeal

The high degree of specialization and requirements for constant renewal also demand new competences. Weak demographic development and a falling interest in technical specialist subjects is a major challenge in Europe which is also felt in Sweden. The fact that growth in the metal and engineering industry is lower in Sweden than in e.g. Asia also means that the influx of new competence and thus new ideas is slower. That younger generations have proved to have a greater propensity to change jobs and thus not built up solid specialist knowledge is also a challenge, particularly for the highly complex metal industry, where it can take decades to achieve true excellence.

Address energy and environmental legislation

Another challenge is to meet the expectations that society can be transformed to achieve significantly higher resource efficiency while at the same time preserving competitiveness and a rise in living standards. Legislation in the EU is designed so that defined goals will be achieved in stages, which means emerging environmental legislation is increasingly complex. It applies to both processes (emissions to air, water and land) and the products. In addition, there are targets and legislation on energy, resource efficiency and reductions in CO2 emissions (by 80 percent by 2050). A major challenge is that legislation not only sets targets but also specifies how they should be achieved, for example "via renewable fuels". This complicates measures to use residual energy that was originally created by fossil fuels. On the whole, the combination of "what" and "how" places unintentional limits on creativity and innovation, and is thus counterproductive in the overall picture. Sweden is different from the rest of Europe in two crucial ways: we have large, comparatively environmentally friendly raw materials and virtually CO2-free electricity, so there is a strong risk that legislation will not consider our situation.

The metal industry is energy-intensive, which is a challenge in itself. If the focus is only on manufacturing processes, without including the overall picture, this can lead to detrimental sub-optimization, because the more advanced materials and products developed to reduce weight and energy consumption in the service may actually require more energy in the production phase.

The Swedish environmental legislation, in particular the licensing process which is unique in Europe, means that we are faced with particular challenges in the implementation of the EU Industrial Emissions Directive (effective from January 7, 2013). The time it takes to obtain permits in Sweden is much longer than in other countries, and this affects the willingness to invest in Sweden for companies that have alternative localization possibilities.

Handle increasing raw materials costs

The availability of raw materials on the global market has been affected by the growing Asian steel industry. Demand for high quality materials means that their prices have evolved faster than those of steel. A strong consolidation among suppliers in certain segments, coupled with shortages in others, has made the price structure and its mechanisms difficult to grasp, let alone predict.

This increased volatility in commodity prices means that inventory now involves large financial risks. Fluctuations in demand can no longer be met by inventory adjustments somewhere in the value chain, but must be directly reflected in changes in manufacturing capacity. This is of course a challenge for all manufacturers of materials, but even for Swedish users of metals, these changing conditions represent major challenges. Low stock levels means that lead times to customers lenthen as demand increases, which could hamper competitiveness. Long transport distances also further increase lead times.

Protect vulnerable value chains

Another challenge is that many players in the value chain have limited scope for their own R & D and therefore have difficulty keeping up when new materials are being developed at an increasing pace. This also applies to maintenance and service providers. Global competition will also force ever-increasing specialization of the various players in the value chain. This often means that the competence of each player narrows and they become more dependent on the other "links" in the chain. Hence, if one link fails, there is a major risk that the entire value chain will be outcompeted by other chains. This tightly-coupled complexity means that weakened competitiveness of individual, small business can have severe repercussions throughout the Swedish manufacturing industry. In the Swedish engineering industry there are small, vulnerable companies that specialize in certain processing steps, such as grinding or polishing, on which many players are dependent.

At the same time, customers want to reduce the number of suppliers, with the consequence that each supplier must be able to offer more substantial commitments.

Seven steps towards renewal, growth and increased competitiveness

1.
Develop market offerings

2.
Open up the value chain

3.
Accelerate materials development

4.
Increase flexibility

5.
Improve resource efficiency

6.
Reduce environmental consequences

7.
Boost industrial competence and appeal

More information about the seven steps can be found at **www.jernkontoret.se**

1.

Develop market offerings

What is important for the customer changes quickly. The world is constantly placing new demands on functionality, sustainability and resource efficiency. Anyone who can best adapt their market offerings, thereby creating new customer value, has the best position to succeed and grow. Today, the Swedish metal industry has extensive experience of selling and creating customer value worldwide. A trend that is already evident and opens new opportunities for added customer value is the rising demand for sustainability, based on concern for our environment and our future. The demands for sustainable solutions are increasing rapidly. In order to address this, there is a need for better models that allow evaluation and demonstration of how sustainability is achieved. Another trend is that customers want fewer suppliers, each of which can undertake major commitments. To deliver these added values and translate them into revenue may require changes to business models and new approaches supported with new knowledge. By using novel decision support technologies, based on systematic, scientific analysis of key areas and phenomena, trends, thoughts, ideas and demands from all over the world can be captured better than they are today. In this way, new customer values can be identified and quickly transformed into new market offerings, for which market and economic risks can be calculated.

The goal is that the Swedish metal industry should have world-leading ability to identify new customer value and meet this with sustainable offerings that increase revenue and push development forwards, even for other materials manufacturers.

The goal is that

”...the Swedish metal industry should have world-leading ability to identify new customer value and meet this with sustainable offerings that increase revenue and push development forwards, even for other materials manufacturers.”

2.

Open up the value chain

An excellent way to give creativity a free reign and identify new needs and opportunities that may be the basis for completely new offerings in new contexts is to consider and work with the entire value chains. In Sweden there are complete, strong value chains from mining to finished, branded products. This means that there are opportunities to open up the chain and connect its stakeholders so that ideas can flow quickly and freely in the pursuit of improved functionality at lower cost, features that can be translated into comprehensive requirements for new materials. Conversely, the information flow can ensure than new materials are described in the most comprehensive way – so that users can put them into service without having to make difficult trade-offs and risking costly mistakes. This can be done by creating fora where those who develop and use metallic materials can meet those with needs for more sustainable solutions and describe their respective realities. Such meetings are particularly important for the small and medium enterprises in the value chain, since they often have difficulty in independently acquiring knowledge about new opportunities and demands. For such customers who need competitive components and systems for their products, current and relevant knowledge about new opportunities is naturally very important. But it is perhaps even more important for a materials producer to understand the trade-offs that are difficult for potential customers, so that the development can focus on just these trade-offs.

In some value chains foreign companies constitute important links, which means that they may need to be involved in the work.

Such a value-chain network also helps to address the demands for comprehensive solutions. However, offers put together by several companies demand some transparency between players and division of revenues and risks between the parties, so this requires business and organizational solutions beyond the purely technical.

The goal is that the Swedish metal industry will both internally and externally create a unique environment that is constantly buzzing with creative ways to combine new advanced metallic materials with sustainable solutions and take them all the way to the end user.

The goal is that

”...the Swedish metal industry will both internally and externally create a unique environment that is constantly buzzing with creative ways to combine new advanced metallic materials with sustainable solutions and take them all the way to the end user. ”

3.

Accelerate materials development

In order to meet the new demands for materials more rapidly, a number of aspects of materials development need improvement. One of these is our material models – how alloy composition and other aspects of materials design affect performance. Another is the understanding of how the various steps in the process chain from raw material to finished product affect the final properties. Since today's manufacturing is largely based on empirical understanding, methods for theoretical and experimental modeling need to be developed in order to increase the possibility to predict and control processes to give the correct properties. Sweden is already a world leader in the above areas. By increasing the pace of development of our models - both theoretical and experimental - we can maintain our lead and thereby our possibility to continue to lead development in the future. But that is not enough. Implementation of the new materials and process knowledge in production requires improved - sometimes newly developed – production technology. This may involves heavy investment and risk-taking. In order to translate products into market offerings, knowledge on how best to use the new material properties in construction, and how the different stages of material production and construction are achieved, is needed.

The goal is that

"...the Swedish metal industry will have a world-leading ability to move rapidly from a materials concept to full-scale production with the right properties to meet a demand for functionality."

The goal is that the Swedish metal industry will have a world-leading ability to move rapidly from a materials concept to full-scale production with the right properties to meet a demand for functionality.

4.

Increase flexibility

If customers' stringent requirements in terms of product features and services are to be met, at the same time as the cost of energy and raw materials, and thus inventory, increases, flexibility in production and distribution must be improved. This requires technology that allows more processing options and fast switch-over. This is partly in order to produce smaller batches of niche materials while maintaining quality at manageable cost, partly to allow substitution between different raw materials, or between raw materials and energy, as price and availability fluctuate in the world market. To increase the flexibility in existing processes requires detailed knowledge of the process variation that can be tolerated to achieve the target material properties – and an ability to keep the process within these tolerances. The processes therefore need to be robust and repeatable. At the same time, knowledge of the variations in material properties that can be tolerated in order to achieve a certain function can be used to further increase flexibility.

The goal is that the Swedish metal industry should be capable of producing niche materials in a short time and in small quantities at a competitive cost, in order to enhance competitiveness and resilience against economic fluctuations.

The goal is that

"...the Swedish metal industry should be capable of producing niche materials in a short time and in small quantities at a competitive cost, in order to enhance competitiveness and resilience against economic fluctuations."

5.

Improve resource efficiency

To ensure that raw materials and energy are used most effectively is undoubtedly a winning strategy in the society of the future. It covers everything from smarter applications supported by improved products through efficient production and increased use of residues to the sensible use of key resources such as metals, minerals and water. Metallic materials have the advantage that they can be recycled, theoretically endlessly. For steel and aluminum, the recycled fraction and the quality of the recycled material are both of great importance for the overall resource efficiency. Enhanced recycling techniques and systems that ensure metallic materials are used in the best possible way within the cycle are therefore a priority. Here, the Swedish recycling industry is following an important strategic agenda.

Better knowledge of how raw materials can be interchanged, and how raw materials and energy can be substituted for each other, makes it possible to choose the most efficient process route in any particular case. By utilizing knowledge from materials development and functional requirements, and developing better measurement and control methods based on modern IT and tailored to the people who use them, processes can be optimized for higher yields and more efficient energy and material use. This means not only using energy efficiently in a specific process, but also being able to define proper boundary conditions by understanding how energy and material interact in and flow across process steps. The ability to reuse materials within the process chain has further increased the potential in this respect.

Resource efficiency also includes the ability to take advantage of all useful metal sources, and several interesting methods for metal recycling have been developed in recent years. Rising raw materials prices increases the driving force to try out new techniques for extraction and refinement.

Metals production uses large amounts of energy. Some of this is turned into residual energy of a lower quality. Ensuring that the temperature of the extracted heat is as high as possible increases the potential for re-using this thermal energy.

The goal is that

”...the Swedish metal industry should be a global leader in the use of all resources in such a way as to maximize resource efficiency in a life cycle perspective.”

But perhaps the most important question is being able to see the big picture. In order to minimize the total resources when people require a certain function, it is necessary to understand how resources are used in the entire chain of processing and utilization, and this knowledge needs to be translated into action where it does the most good. It is quite conceivable that resource efficiency can actually be improved by using more energy and raw materials in metals production, if this improves efficiency later in the chain. Stronger materials for lighter vehicles or improved corrosion protection for longer life are simple examples of this concept. In order to understand more complex relationships and avoid sub-optimization, improved models are needed of where, when and in what quantity various resources are used. The goal is that the industry will use the necessary resources as efficiently as possible to maximize resource efficiency in a lifecycle perspective. One way to increase the overall resource efficiency is to utilize the full potential of waste energy. To exploit these opportunities, however, requires broader system boundaries, collaboration across sectors and in some cases, changes in legislation.

The goal is that the Swedish metal industry should be a global leader in the use of all resources in such a way as to maximize resource efficiency in a life cycle perspective.

6.

Reduce environmental consequences

Metal industry processes affect the environment through emissions to air and water, noise and deposited waste. An intense and dedicated effort to reduce the environmental impact is already well underway and major steps have been taken. To continue this work and be able to take action on the right direction requires new and better understanding of the environmental effects of emissions and waste, as well as techniques to reduce them. Carbon dioxide is a highly prioritized area where extensive research and development is needed to reduce emissions radically. This research includes completely new reduction technologies, alternative fuels and the ability to collect and store carbon dioxide. The development of pilot and demonstration scale facilities is also needed. Air emissions of nitrogen oxides and dust are consequences of the use of fuels and combustion technologies in high temperature processes. The developments in energy efficiency must be weighed against the impact on emissions. With regard to emissions to air, water and land, methods for assessing the environmental effects are required. The focus is to identify opportunities for action early in the chain by reviewing raw materials and other sources. The amount of waste and its environmental impact can be reduced through the development of process technology and pre-treatment techniques and/or the selection of recycling pathways.

The goal is that the Swedish metal industry should be a global leader in terms of causing minimum environmental impact from a life cycle perspective.

The goal is that

”...the Swedish metal industry should be a global leader in terms of causing minimum environmental impact from a life cycle perspective.”

7.

Boost industrial competence and appeal

All progress comes from motivated, committed and competent employees who jointly strive towards the operational goals. It is thus crucial that employee development and competence are a focus point in all endeavours. If the Swedish metal industry is to be able to maintain the right skills, it must be viewed as attractive. This means that the industry's interesting challenges, which ultimately are opportunities to influence world development, need to be highlighted, while typical labels such as "old fashioned" and "dirty" need to be challenged and their causes removed. One important factor is the introduction of modern ways of working in exciting and attractive work environments that match young peoples' aspirations. To further increase the attractiveness requires a long-term effort to profile and highlight the strengths and development potential within the industry, and how it affects us and our daily lives.

In the next step, the people coming into the industry want to build their skills in a purposeful way. This requires opportunities for rapid competence and skill development and specialization, as well as help in choosing ways forward.

One way to strengthen the competence of both new and existing employees is to ensure that research results and other important knowledge quickly reach those who need them. For this to be the case, they must be presented in such a way that they are easily understood, accepted and applied. Finding innovative, efficient ways to disseminate knowledge and research is therefore essential. Another way to increase industry appeal and enhance skills is to give everyone the opportunity to contribute to the development, which may require new tools and working methods.

In order to provide enduring competence development, close links between universities, institutes and industry are of great importance. A future vision includes a centre with various research and educational directions, all based on real industrial needs, in which all aspects of the competence requirements in the industry are highlighted and where people can move freely and easily between organizations and specialties.

The goal is that the Swedish metal industry will be ranked as one of the most attractive places to work and also attract foreign researchers and specialists. It should be recognized for providing interesting and challenging work that leads to personal growth.

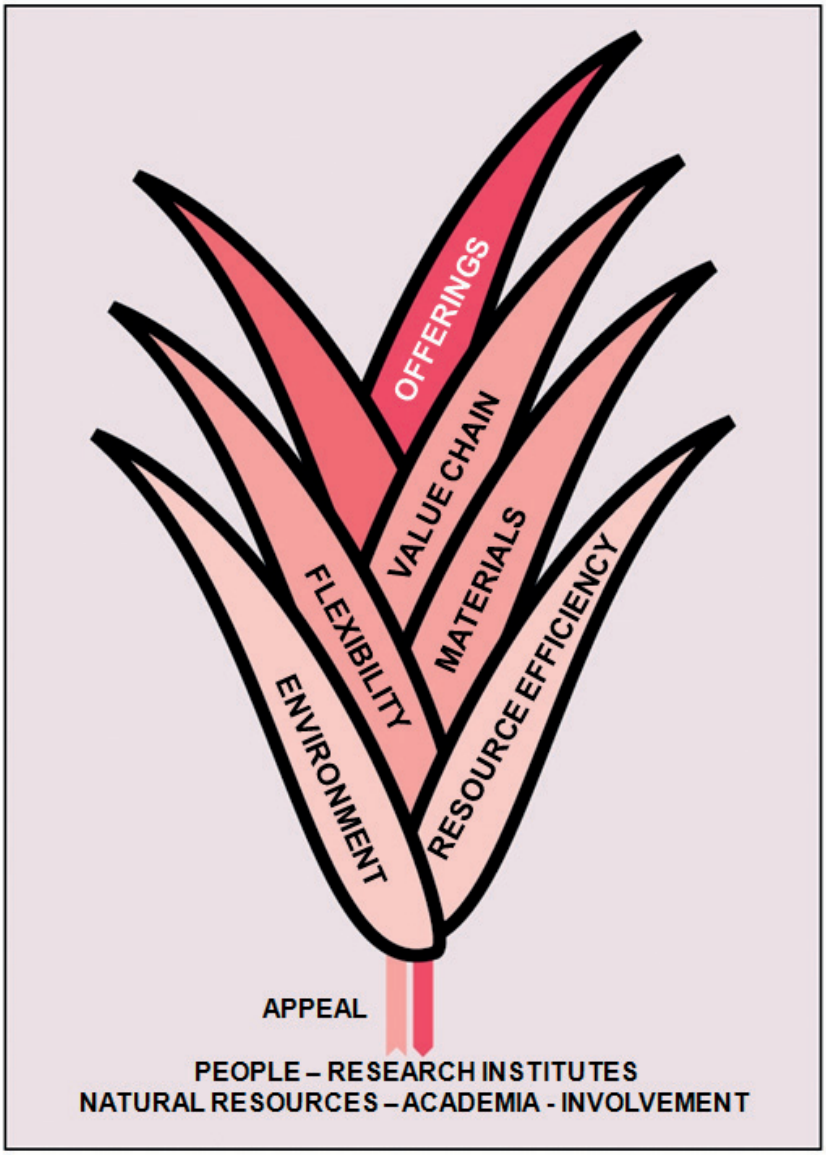
The goal is that

"...the Swedish metal industry will be ranked as one of the most attractive places to work and also attract foreign researchers and specialists. It should be recognized for providing interesting and challenging work that leads to personal growth."

Criteria

Achieving the “Seven Steps” requires a series of actions. In order to select activities which will contribute in the best possible way to achieving the goals, the following criteria will be used:

- Does the initiative address the agenda’s objectives?
- Will it have a significant impact on the innovation area?
- Are the intended benefits clear? Can they be achieved in a clear fashion?
- Is there a clear idea of how the results will be implemented? Will the results reach those who need them?
- Does the initiative contribute to resource efficiency in a system and life cycle perspective?
- Is it sufficiently innovative and at the same time have a potential to succeed?
- Are the right competences being used to address the question? Are all opportunities for involving appropriate contributors utilized?



The intent of this strategic innovation agenda is that indomitable flower of the Swedish metal industry will grow and bloom even more beautifully. Offerings are secured in value chains and develop from an environment of increasingly sophisticated materials, flexibility, resource efficiency and environmental benefits. Through its appeal the flower is nourished by a base of committed people, knowledge and resources.

The industry's resources

"... a variety of resources for research and innovation, and annually invests more than 1000 MSEK in such activities."

Today...

The Swedish metal industry today has a variety of resources for research and innovation, and annually invests more than 1000 MSEK in such activities.

In addition to the companies' own research departments, experimental workshops and laboratories, there is an infrastructure of universities and institutes with relevant competence and equipment. Courses specifically relating to metallic materials at B.Sc. and M.Sc. levels are given by i.a. KTH Royal Institute of Technology, Luleå University and Dalarna University. A graduate program for the steel industry is coordinated by Dalarna University and is the second in a series, the first series being completed in 2012.

The major experimental facilities available include LKAB's experimental blast furnace, operated by Swerea MEFOS, where many of the world's major steel companies run tests. There are also different types of equipment for materials synthesis, processing and coating, mechanical, thermal and chemical analysis, microscopy studies and equipment for simulation and other modeling. Swedish metal research also has access to the synchrotron PETRA III in Hamburg, and will participate in the development of the MAX IV in Lund, albeit at a modest level.

The Swedish metal industry is involved in research at European level. The Research Fund for Coal and Steel (RFCS) was formed in 2002 using the remaining funds from the Coal and Steel Union. It annually awards approximately 40 M€ to steel research, an area in which Swedish participants have been very successful over the years. On average, Sweden has received three times higher grants than would be expected on the basis of the size of the country. Several companies are also involved in EU Framework Programs in different ways.

Many Swedish companies have a global presence by virtue of their own facilities for processing and sales, in many cases also production, which means that they are involved in development partnerships with customers and researchers all over the world. Some companies are part of international groups and thus have natural contacts to research and innovation in other countries.

Jernkontoret (the Swedish Steel Producers' Association) has for a long time had an organization for joint research, divided into 14 Technical Areas and a number of councils, such as Energy, Environmental Issues, Research and Education, Product Ecology, Standardization and Quality, where the industry can work together to discuss current issues. The steel industry is also, via trusts and holding companies, a major shareholder of the research company Swerea, with interests mainly in the institutes Swerea MEFOS and Swerea KIMAB.
In order to develop and expand the industry's global presence, Jernkontoret formed the "Council for Development of customer value and service" in 2013. In this forum the member companies can highlight the customer value that can be realized in different parts of the world, and develop concepts.

The Swedish Foundry Association (Gjuteriföreningen) organizes the Swedish foundries and has an ownership role in Swerea with particular interest in Swerea SWECAST. Swedish Aluminium (Svenskt Aluminium) has a role equivalent to that of Jernkontoret for the aluminum industry, but is a much smaller organization and currently lacks resources for coordination. Swedish Aluminium contains the cluster "Aluminiumriket", which also includes foundries. Jernkontoret is involved in the "Triple Steelix" cluster, which develops the steel industry and its' associated companies in the Bergslagen district, and in Värmland the non-profit association" Steel and Engineering" has the same role.

… and in the future

By coordinating and developing its resources, the Swedish metal industry can create an infrastructure that provides strength and stability to the area and makes it possible achieve the role described in the vision.

This means that by the year 2020 the industry should have:

... a range of new business models that allows companies within the industry to generate significant revenue from other sources than the sale of the material which it has produced. There might already be the first metals company without its own production, and even one with a completely new type of manufacturing.

... an experimental and computational infrastructure that covers all the experimental and computational resources required to develop, characterize and standardize new materials. Parts of this infrastructure - especially expensive equipment that is rarely used - may well be abroad, while more frequently used equipment is in closer proximity to the users. The first step towards this goal is a thorough analysis of available resources, assessed against current needs. The next step is to make this mapping known to all stakeholders, and the third step to make necessary additions and extensions.

... an education system that attracts young people and prepares them well for their future. In addition to more general education, this should encompass broad introductions such as “Metal industry business logic” or “Sustainable value creation” as part of an economics or marketing courses, or “Metallurgy for engineers” to demonstrate the potential of metals to all types of engineers. Very deep specialist courses aimed at key personnel are also needed. An interdisciplinary graduate school, where different aspects can be addressed simultaneously so that the broad picture can be seen and thus future knowledge developed in a focused and coherent way. The system extends beyond traditional educational systems and includes mentoring programs and short training programs offered widely and made available through modern IT tools. To get to this stage requires an even closer collaboration than today between the industry, institutes and academia - enabling an interaction in which people can move freely and seamlessly between the different worlds and ensure working with state of the art knowledge and rapid capture of new ideas and achievements, regardless of where they originate.

... an advanced collaboration within and between sectors, where thoughts, ideas and issues are discussed and in which participation is an obvious method of keeping up to date and at the cutting edge of development.

... joint “workshops” - virtual or real - where problems owners from all sectors of society can quickly find the right competences to identify or develop the right materials, find the right design for a demanding, innovative application, or mitigate environmental consequences. Around these workshops the will be a continuous growth of new companies that develop businesses and utilize the industry’s global presence to attain rapid export growth.

”... can quickly find the right competences to identify or develop the right materials, find the right design for a demanding, innovative application...”

Connections with other agendas

Several other strategic agendas concern the innovation area metallic materials. On the raw material side, there are, for example, the mining industry's agenda and the agenda for the recycling industry, "Resource efficient material utilization". Although the former focuses its efforts within metallurgy on the recycling of base metals, several techniques will be interesting for the metal industry when it comes to handling of residual products and purity of the raw materials it uses.

The recycling agenda addresses sustainability and quality and its realization will help the metal industry to increased sustainability and resource efficiency.

ProcessIT's agenda PIIA focuses on new possibilities to visualize and integrate processes and could, together with "Internet of Things", contribute to a complete alteration of our way of observing and controlling processes. Although several of the metal industry's suppliers of equipment today offer systems for control- and visualization of their particular equipment, integrated solutions are rare. Via these agendas, the metal industry can find help to identify modern and appropriate solutions that are attractive to employees and make it possible for them to understand and overview process activities and thereby contribute to their development.

"...the metal industry can find help to identify modern and appropriate solutions that are attractive to employees and make it possible for them to understand and overview process activities..."

Nanotechnology is becoming increasingly interesting to the metal industry and the agenda "Nanotechnology for a sustainable society" contains important steps to further increase possibilities with this technology.

On the user side, there is "LIGHTer", with a clear vision for lightweight construction and a clear idea about materials solutions that constitute very important input to the metal industry. This is also the case for "Swedish production", with its ambition to develop more sustainable production systems and solutions.

On the business side there are for example "Service innovation" and "Lifecycle based innovation" which both could provide important contributions to the innovation area metallic materials through their focus on broad concepts and new business models.

Companies and organisations who support the agenda

Swerea AB
Swerea KIMAB
Swerea MEFOS
Swerea IVF
Swerea SWECAST
IVL
VTI

SSAB
Ovako
Outokumpu Stainless
Sandvik MT
Uddeholm
Höganäs
Surahammars Bruk
Suzuki Garphyttan
Scana
Ruukki
Erasteel
Morgårdshammar
Fagersta Stainless
Hörle Wire
Böhler-Uddeholm Precision Strip
Carpenter
Celsa Steel Service
FNsteel Hjulsbro
Ramnäs Bruk

ProcessIT
SIS

ScanDust
Harsco metals
Avure
Metec
Vargön Alloys
Lindskans slagg
Umbilical Design

Kungliga Tekniska högskolan
Luleå tekniska universitet
Högskolan Dalarna
Uppsala universitet
Linköpings universitet
Karlstads universitet
Mälardalens Högskola
Mittuniversitetet
Chalmers tekniska högskola
Örebro Universitet

Bodycote
Kubal
Sveriges designer
Stena Aluminium
Profilgruppen
Husqvarna
Metallfabriken Ljunghälls AB
Sapa Profiler AB
Föreningen Svenska Pressgjuterier

SAMS
Teknikföretagen

AB Volvo
Siemens
Scania
ABB
LKAB
AGA
Höganäs Bjuf
Radarbolaget
Prevas
Cortus

METALLIC MATERIALS FORM A BETTER FUTURE

This document constitutes a strategic agenda for development and renewal in the area of metallic materials. For the first time ever, the Swedish metals-producing industry unites in a common research and innovation effort for the future.

The agenda describes a number of measures in order to achieve renewal, increased competitiveness and sustainable growth in the Swedish metal industry, as well as in its relations to suppliers, users and indirect customers.

The Swedish metals-producing Industry's associations:

The Swedish Steel Producers' Association (Jernkontoret)

Swedish Aluminium

Swedish Foundry Association