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Environmental regulations, market pressure or own driving force – what are the potentials for Swedish companies to take the lead?

A case study with examples from three different enterprises operating in Sweden – aiming at taking the lead

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Preface

Sweden desires to be frontrunners in environmental technology and in the environmental debate it is often said to be a win-win situation i.e. companies will gain market shares and increase competitiveness thanks to products (and also processes) with environmental performance in the front line. Politicians state that tough environmental regulations will shape the frontrunners. Some NGOs admit.

Sweden as a country has for a long time declared a desire of a sound and healthy environment. Sweden also wants all activities in society to strive for a sustainable development.

But is it profitable both economically and competitively to take the lead environmentally for Swedish companies –considering that many operate internationally? Is innovation or regulation the key driver? Is it the companies own will based on awareness combined with market pressure that is the key driver/drivers? Issues like willingness-to-pay dilemma including end consumers' behavior and mindset as well as appreciation regarding new product performance is discussed.

This study is based on in depth interviews with three companies in Sweden: Södra Cell (1991), Volkswagen (1999) and SSAB (present) – all frontrunners when it comes to introducing new products with high environmental performance at different time periods.

Recently a new way of measuring a country's contribution of greenhouse gas emissions has been introduced by economic researchers at Lund University. Technology adjusted footprints incorporate emissions embodied in trade, but also adjust for differences in carbon efficiency in export sectors of different countries. Sweden's export of products with high environmental performance significantly reduce Sweden's greenhouse gases.

Companies' ability to introduce environmental advantages through products with high environmental and business performance can be further read about at advantageenvironment.com. More than 300 articles can be found on this site, describing both small and large companies work to achieve environmental advantages.

This study has been conducted by Linda Stafsing, during autumn 2015, as an intern at Confederation of Swedish Enterprise. It is part of her studies; Master of Science in Environmental and Natural Resource Economics at University of Copenhagen.

Confederation of Swedish Enterprise has supported the study in order to introduce a broader understanding of the risks and market potentials for a company willing to be a frontrunner.

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The Confederation of Swedish Enterprise is Sweden's largest and most influential business federation representing 50 member organizations, which basically covers almost the entire Swedish business. There are in total 60,000 member companies ranging from pure service providers for the process industry, and includes transport, trade and construction sectors. The confederation of Swedish Enterprise represents companies of various sizes from all over the community. In total, our member companies consist of about 1.6 million employees, and most of our member companies are small. In about 66 percent of the companies, the number of employees are less than 10.

Contents

1 Executive summary

This paper examines how Swedish companies are affected both competitively and financially from taking the lead in environmental innovation, through three different case studies over three different time periods. The three cases are based on environmental technology innovations developed by Södra Cell in 1991, Volkswagen in 1999 and SSAB at present time. Politicians often claim there is a win-win effect from taking the lead in environmental innovation, and that regulations are necessary for companies to find efficiency possibilities and in turn invent technology with better environmental performance. The red thread through the paper is based on the Porter hypothesis from 1995, which states that environmental regulations lead to resource- and energy efficiency that in turn will create improved competitiveness and economic growth. The Porter hypothesis questions the efficiency capacity within a company and assumes that a company per se is not capable of finding efficiency possibilities without regulations. It is a controversial theory, but what can be seen from the case studies is that the market demand and efficiency improvements are strong driving forces. Evidence for the Porter hypothesis is therefore not to be found in the following paper.

Another theory discussed specifically for SSAB is the technology adjusted consumption-based accounting model (TCBA), that includes a life cycle assessment and a global perspective for a product's total environmental benefits. It is for the first time possible to measure this approach and Sweden has an advantage thanks to great investments in technology improvements. Instead of focusing on the end product emissions, Swedish companies put a lot of effort in research to improve the entire production process and reduce emissions from the cradle to the grave, as SSAB's high strength steel shows. This opens up a possibility for Sweden to use this advantage and reduce emissions on a global level through climate smart exports.

The most important finding from the study is that long term policies are essential in order to create sustainable solutions and maintain a clear path forward. Conclusions discussed further are that it is innovation that triggers new regulation, not the other way around. Innovations generate new ideas and knowledge which in turn can be a platform for regulatory measures for the rest of society to follow. A dilemma that is very accurate today and has been since the environmental debate started is the willingness-to-pay, for technology with higher environmental performance. It is difficult for enterprises to charge a higher price for a new product or technique that performs better from an environmental perspective. It is a mindset within society that has to transform in order to accept new technologies faster and easier. The last topic in the discussion is if being the second runner instead of the first runner is more profitable. The first runner takes a great risk and it is expensive in terms of research and time to come up with new technology, whereas the second runner can get all the upsides at a lower cost. The ability to impact might be limited and is a question of concern, especially for enterprises operating in a small country like Sweden while still competing on an international market.

The case studies are conducted from interviews with people in charge of the environmental affairs at each company respectively. The paper is further based on research papers to support the theories as well as information about the different products. Hopefully this study will give a more nuanced image of what it implies for Swedish companies to take the lead.

2 Introduction

Regulations, market pressure or inner driving force – is the Porter hypothesis still accurate or are there other influences towards greener products?

Sweden desires to be frontrunners in environmental policies, with reduced emissions and improved resource efficiency. It is achieved through regulations but also from increased market pressure and business involvement in producing smarter products with higher environmental performance. The critical question though is what it really means to be a frontrunner? There is not one simple answer to that question and especially not a clear definition. There are several countries that can be described as frontrunners in different areas but it is often subjective and definitely not a uniform agreement on what it actually implies. However, Sweden is striving to be a first mover and hopefully some real-life examples will ease the understanding of what it means to be a "frontrunner".

The Swedish consumer is today more aware and informed about climate change, and daily consumption choices are more influenced by the environmental impact and carbon dioxide footprint. Both the market, government, agencies and organizations put a lot of pressure on Swedish enterprises and we see a lot of impressive innovations and successful investments, but is it fully correlated with profits and success? How is competitiveness affected from environmental regulations along with pressure and expectations from the Swedish consumer and the value chain via B2B?

This is a project to analyze if being a frontrunner in environmental issues leads to sustainable development for society and if there is a win-win situation from taking the lead. Sustainable development considering the environment, the economy as well as society. What are the upsides and downsides for a company to take the lead in environmental concerns and when is someone actually taking the lead?

According to a report written by OECD (2015), *Do Environmental Policies affect global value chains*, stringent policies put polluting intensive industries, at a comparative disadvantage. This might result in increased imports from countries with less stringent environmental policies and therefore contribute to dirtier production. For the industries polluting less on the other hand, environmental policies will give a comparative advantage and help boost exports if they still can be competitive economically.[1]

Environmental policies in Sweden are characterized by "taking the lead". Sweden has chosen an ambitious climate policy target, a target that is more ambitious than for the European Union. The goal is a reduction of greenhouse gas emissions by 40% by 2030, compared to the 1990 level. To achieve this goal, Swedish enterprises need to change production along the entire value chain[2]. Sweden was one of the first countries to introduce specific taxes on carbon dioxide already in 1991. Statistics today show that Sweden has lowest emissions per capita in the EU and rank among the three lowest for OECD. Is this because of the tough regulations and stringent policies, and if so has it contributed to better productivity and greater profits for the business?[3]

[1] OECD. (2015).
[2] Broberg,T et al. (2010).
[3] Brännlund, R. (2007).

Sweden has also chosen an overall ambitious environmental policy target by introducing long-term Environmental Objectives to be met 2020 focusing not only on climate but also on chemicals, air, water, forestry and agriculture land use, biodiversity among others.[4]

2.1 The Porter Hypothesis vs Neoclassical Theory

The hypothesis about strengthened competitiveness from taking the lead and greater profitability from environmental regulations, has evolved from the Porter hypothesis, by Michael Porter in 1995. The Porter hypothesis claims that a country with well-designed environmental policy tools can boost productivity which leads to economic growth and hence improve competitiveness on the global market. It is however not described further what well-designed policies would look like. Environmental taxes, subsidies and incentives are usually the type of policy referred to by other researchers and experts on environmental regulation. The key message from the Porter hypothesis is that under correct structured environmental regulation, profitability and increased competitiveness goes hand in hand.[5] The Porter hypothesis therefore denies the traditional neoclassical approach saying that environmental regulations impose additional costs on companies and negatively affects competitiveness on the market. Michael Porter further assumes that environmental regulations create a demand for environmental improvements and therefore supports innovative enterprises and frontrunners. In the long run, investments in environmentally friendly technique could have positive effects both regarding lower costs but foremost less impact on the environment. The hypothesis is very controversial since it assumes that companies per se are inefficient and incapable of finding the inefficiencies themselves, but need strict regulations to achieve it.[6] One of the most common counterarguments is that there is no such thing as a free lunch, everything comes at a cost, including efficiency improvements.[7]

The hypothesis is the total opposite from what traditional economy states, where these kinds of investments in theory would lead to lower profits. Neoclassical theory states that productivity is disadvantaged because labor and capital is reallocated from productivity to research and innovation to meet new demands. Emitting used to be for free, whereas today there are taxes regulating emissions and this is, according to the neoclassical school, a way of reducing social benefits and hamper productivity.[8]

Michael Porter further claims that possibilities for competition are characterized by organizational inertia. Research takes time, and whenever a new technological innovation is available on the market, there is a short period of time to get strengthened competition. This is because of the sluggishness theory that it takes time for a company to adapt and catch up on the latest technology. Environmental regulations bring the opportunity to compete with technological improvements within the environmental field. This is a relatively new way of competing on the market, which had not been seen a lot before the 1990s. But companies will always take the opportunity to perform better and environmental innovation is one of them. *"Hence, given that the revenues exceed the costs, the hypothesis is often regarded as a "win-win" hypothesis, as it suggests that firm profits increase via improved competitiveness at the same time as the environment improves".*[9]

[4] Naturvårdsverket.
[5] Broberg,T et al. (2010).
[6] Alfredsson, E et al. (2013).
[7] Brännlund, R. (2007).
[8] Alfredsson, E et al. (2013).
[9] Broberg,T et al. (2010).

The very foundation of the Porter Hypothesis is that investing in environmentally friendly technique goes hand in hand with improved resource productivity, which can be achieved under proper environmental regulation. These assumptions claim that climate policy not only is for free, but it would also create extra profits[10]. Further Porter argues that investments in product and process changes should be encouraged, rather than pollution control treatment, since it is more costly. It has for many decades been a priority for Swedish industries to solve the problem at the source where they occur.[11]

2.2 The Swedish perspective

The Porter Hypothesis is often used in a Swedish context to emphasize the importance of why Sweden should "take the lead" in environmental issues. This topic is discussed among others by Runar Brännlund, a Swedish professor at Umeå University and member of the government's Scientific Council on Climate. He asks if a small country like Sweden really should put up more ambitious climate goals than other developed countries, or if Sweden only should do what is required according to international agreements?

Both the theoretical and empirical research concludes that environmental regulations are joint with costs. According to a report written by Brännlund and Lundgren (2009) there is "*lack of strong evidence for the existence of a strong Porter effect. However it should also be noted that the literature does not provide 'strong' evidence against the hypothesis either*"[12]. Another paper from *National Institute of Economic Research* concludes that their results give no support for the Porter hypothesis. There is no significant correlation between investments in environmental protection and total efficiency. Explanations to this could either simply be that there is no Porter effect or that the relative size of investments in environmental protection compared to total investments is very small[13]. A report from OECD on the same topic shows no evidence that stringent environmental policies would have a negative effect on competitiveness from a country perspective, note that it is not a single business perspective.[14]

Nevertheless, professor Brännlund states that environmental regulations come with costs and this must not be neglected. He points out the importance of balance between utility and costs within the industry that must not be forgotten. If this is not stressed enough, climate politics could lose reliability, since there is no such thing as a free lunch.[15] Brännlund points out the importance of economic instruments such as taxes, to give clear incentives for companies to invest in cost-saving technology as well as energy-efficient innovation, but must be set with a long-term perspective and ensuring dynamic efficiency.[16]

Business is a key player when it comes to combating climate change and linked environmental issues. Businesses have the opportunity to disseminate and improve technology and innovations that can help reduce the anthropogenic environmental footprint. According to an article by Confederation of Swedish Enterprise, the Swedish Trade Union Confederation and the Federation of Swedish Farmers, Swedish businesses should take the lead globally by creating climate friendly products and services.

[10] Brännlund, R. (2007).
[11] Broberg,T et al. (2010).
[12] Brännlund, R & Lundgren, T. (2009).
[13] Broberg,T et al. (2010).
[14] OECD. (2015).
[15] Brännlund, R. (2007).
[16] Brännlund, R & Lundgren, T. (2009).

Swedish businesses should through its hard work be part of reducing global emissions and strive for staying at the top. Nevertheless, the competitiveness must remain equal among countries worldwide to maintain business operations on a fair basis[17].

Hence, is the Porter hypothesis of any relevance or is maybe the real world slightly more complicated? Hopefully three cases from the real world will help to get a better understanding of how it is to operate a business in Sweden, while at the same time trying to take the lead.

Three cases will be examined:

1. Södra Cell – chlorine-free pulp. Time period: 90s.
2. Volkswagen – Lupo 3L TDI, a car that runs on 3 liters/100 km. Time period: 1999–2005.
3. SSAB – High Strength Steel. Time period: present.

[17] Jonsson, H et al. (2015).

3 Södra Cell – Chlorine-free pulp became reality after tough pressure from NGOs and the market

Case examples

3.1 Södra Cell and the Porter Hypothesis

In the report "*Environmental Policy without costs? A review of the Porter Hypothesis;* the authors Runar Brännlund and Thomas Lundgren describe the Swedish pulp- and paper industry, Södra Cell, during the 90s when the chlorine-free bleach technology was developed and how it is related to the Porter hypothesis. Södra Cell introduced environmentally friendly bleaching processes, which forced the suppliers to adapt because consumers wanted paper bleached without chlorine. International demand successively increased and Swedish producers had an advantage thanks to improved paper-bleaching technology, and thus gained greater international market shares. Porter refers this scenario to a "first mover advantage". In this case it was not only the regulated paper pulp industry that gained increased competitiveness, but also paper suppliers in the same market experienced greater sales thanks to improved technology.[18]

3.2 About SÖDRA Group and Södra Cell

In 1926 a group of forest owners in southern Sweden merged to become stronger in order to protect a decent price on wood raw material. This group of people has continued to grow and SÖDRA group is today owned by a cooperative of 52,000 forest owners in southern Sweden that together own 36,000 forest farms. It is based on small scale forestry with a strong local affiliation and relationships. Södra is very active in business policy to represent all forestry members. Södra is therefore very engaged in social issues and relevant debates and has an ongoing dialogue with organizations active within Södra's interest areas.[19]

Today SÖDRA Group consists of three different areas; Södra Skog, Södra Wood and Södra Cell. Södra Cell is the biggest business area within SÖDRA Group. Södra Cell consists of three market kraft pulp mills; Värö Mill, Mörrum Mill and Mönsterås Mill.[20] Södra Cell has chosen to focus the operation on pulp and the pulp is mainly retrieved from coniferous forest (90%), whereas the rest mostly comes from birch forest. Total yearly production from all three pulp mills is 1.6 million tons.[21] This case study will focus on Södra Cell and the environmental technology development during the 1980s and 1990s.

[18] Brännlund, Lundgren, *Environmental Policy without costs, 2009*.
[19] Södra Skogsägarna Ekonomisk Förening. (2015).
[20] Löfblad, R. (2004).
[21] Södra Cell. (2013).

Figure 1: The three pulp mills in southern Sweden.[22]

3.3 The environmental debate advanced

The information below is based on Roland Löfblad's own experience as former Environmental Director at Södra Cell between the years 1988–2007.

The story about how Södra Cell became world leading in environmental performance begins during the 1980s when the forest industry experienced greater pressure to care for the environment, both from the market but foremost the Swedish Environmental Protection Agency. The Environmental Protection Agency had taken water samples outside a kraft pulp mill where among other effects; malformed sick fishes had been spotted. The samples showed that the water contained organic chlorine compounds from chlorine bleaching at the mill. A few years later, in 1986, the debate took off again when crabs at the west-coast of Sweden outside the Södra Cell Värö mill was found to contain dioxins which also blamed the chlorine bleaching at the pulp mill. Dioxins can be very toxic in greater amounts, but the amount in the crabs was not harmful to humans.

When the dioxins were detected, Greenpeace quickly seized the opportunity to inform the public about the seriousness in the case and to increase pressure on the pulp factories to remove the chlorine-gas in the bleaching process. One famous demonstration Greenpeace did was in 1987, during the authorization negotiations regarding an extension of the Värö mill. During the negotiations, right before lunchtime, Greenpeace together with TV-journalists walk into the room with crab-sandwiches to serve Roland (a consultant to Södra Cell at that time) and other representatives from Södra. This was a symbolic way of showing that crab was under the circumstances not very healthy to eat after the dioxins had been detected.

Because of the high pressure from the public and authorities, Södra decided to assign an Environmental Manager in charge of environmental issues at Södra Cell, Roland Löfblad.

[22] Södra Group. (2013).

Roland started his employment at Södra in 1988, when the bleaching process had been questioned and impacts on the environment from chlorine deposits were detected. Södra got a lot of pressure to change their bleaching process and Roland did everything he could to support Södra and the production method to alleviate the situation under the circumstances.

There were other factors influencing the debate regarding the environment at this time. Seals were for example very exposed in media during 1988, when an unusually high number of dead seals were discovered along the west coast. This also put the pollution from the industries in focus. It was later identified that the seals died because of a virus, but it gave the opponents extra strength. At the same time unusually high amounts of toxic algae were identified along the west coast which killed fishes and other living organisms along the coast. This was also interconnected with industrial effluents, but researchers have later realized that the amounts of algae vary because of other factors. Because the environment got a lot of attention, the Swedish Environmental Party was for the first time voted into Parliament at the election in 1988. All these factors put even more pressure on Södra and the forest industry to remove the chlorine gas in the bleaching process. The problem for the industry though was that it was very difficult to get the same quality, strength and brightness of the paper without using chlorine gas.

3.4 The market forced the industry to change

A few years later in 1991, Greenpeace managed one more time to shed light on the chlorine bleaching debate. Big headings were seen in the newspapers when Greenpeace had printed Das Plagiat, a plagiarism of Der Spiegel, with paper made from chlorine-free pulp. It was a statement from Greenpeace that is was possible to bleach pulp without chlorine, and to question why the pulp factories could not do it. This only added on to the pressure from the market and consumers demand for chlorine-free pulp to protect the environment.

Where did Greenpeace then get their chlorine-free paper from? Another company called EkaNobel (today Akzo Nobel), had been experimenting with hydrogen peroxide instead of chlorine gas and mill trials were performed at another Swedish kraft pulp mill. Greenpeace had bought paper made from pulp bleached with hydrogen peroxide from that mill when Das Plagiat was printed. The German paper factory who printed Greenpeace's paper became popular afterwards because other printing and commercial agencies asked for the chlorine-free paper. Since the end consumer that bought the book or magazine had enough knowledge to know what to demand for, the market had the power to put pressure on the forest industry.

In the beginning of the 1990s when the debate was peaking, a serious recession hit Sweden. The recession has later been referred to as a depression because of the serious fall in the economy. As a consequence from the recession, demand decreased heavily and the Swedish economy was severely affected and dropped quickly. In 1991 after the second big demonstration from Greenpeace, Södra had no choice but to give in to the market demand and invest in chlorine-free bleaching technique.

This decision was solely based on the market pressure and the strong message from the consumers, while the Environmental Protection Agency played a minor role. Politicians and agencies had put a lot of pressure on Södra, but they were easier to reason with, compared to the market that was only satisfied when the chlorine-free pulp became reality.

3.5 Great investments necessary to meet consumer demand

The year after, in 1992, more than 10 million SEK was allocated to Södra Cell's budget to communication and marketing to communicate to the market and the end consumers that chlorine-free pulp was on its way. At this point, Södra Cell was certain that they in the near future would be able to bleach pulp without chlorine because they had already made the necessary investments for replacing chlorine chemicals with hydrogen peroxide in the bleaching process. This was a completely new way of communicating and almost no money had ever been invested in marketing before within Södra Cell, since Södra delivered products B2B and was considered a conservative business. Commercial for Södra's pulp in that extent had never been seen before.

The commercial and marketing efforts were a success. The commercials were very humoristic and clever, but foremost it was aimed at the end consumer buying printed paper and not the paper printing factories that bought the pulp. This was very effective and the consumer became well aware of Södra's investments and future product, the chlorine-free pulp. The chlorine-free pulp became known as TCF pulp, Totally Chlorine Free, and TCF pulp from Södra Cell was branded Z-pulp where z stands for zero as in zero chlorine. Z was used in a lot of commercials where Södra referred to various famous people like actors and singers. As an example, Södra did a CD with Frank Zappa where z was referring to both Z-pulp and Zappa, which was a great success. An old and conservative business had suddenly turned 180 degrees to become modern, humoristic and reachable to the consumers.

Södra Cell Värö mill was the pilot factory for the project to bleach without chlorine gas and a lot of money and workforce was invested to reach the goal fast. Thanks to earlier big investments, like extended cooking and oxygen bleaching, the chlorine-free pulp became reality in fall 1991, also known as TCF, Totally Chlorine Free. Södra had succeeded but the new pulp neither had the same quality nor the same brightness as traditional chlorine-bleached pulp. However, this did not matter at the time because demand was higher than supply and consumers were eager to buy the paper made from chlorine-free pulp. The price for one ton of kraft pulp was at the time US$ 600–700, but thanks to the high demand and low supply on the market, the price for chlorine-free pulp was about 10–20% higher than traditional pulp. Paper factories, foremost in the German speaking countries, were basically standing in line to buy the chlorine-free pulp and this created the great premium on TCF pulp. In addition to the price premium, the base price on pulp rose significantly during the early years in the 90s, the peak was in 95 when one ton pulp was sold for US$ 1,000. Södra could not have foreseen the price premium, it was initially an extra bonus along with strengthened competitiveness because of the hard work. Successively the brightness and quality of Z-pulp increased and in 1995 the TCF pulp was at the same quality level as standard pulp. That year, the price premium was more or less gone and Södra was no longer able to charge a higher price for TCF pulp. However, since this happened during the recession in Sweden it became extra apparent how this favored Södra. Other companies had to shut down or cut production considerably while Södra could sell everything that was produced, despite the worsened quality of the pulp at the beginning. Afterwards Södra calculated that the additional value from Z-pulp was worth €90 million in extra revenue* the first five years.[23]

[23] Bingel, E & Sjöberg, C (2003).
*Only the revenue is taken from this source.

The chlorine-free pulp created an added value to the paper, a new quality on the paper was created, and the environmental factor suddenly played a major role. Before the paper quality like whiteness, brightness and strength was the most important characteristics, but when TCF reached the market, the environmental quality factor played an even bigger role. However, the worsened quality was overlooked before supply and demand was back in balance when other pulp factories outside Sweden started producing ECF, Elementary Chlorine Free pulp.

3.6 TCF vs ECF

Södra was the first company to introduce TCF, pulp bleached with hydrogen peroxide. Most other factories never took after this technique, but instead produced ECF, which is a bleaching process where chlorine-gas is substituted with chlorine dioxide. Hence, ECF was never actually chlorine free, even though chlorine dioxide did not harm the environment as chlorine gas did. Södra was pretty much the only one to produce TCF and they soon realized that other companies had to produce TCF as well to make it competitive on the market. Since Södra could not supply Europe with TCF themselves, paper factories would eventually have to accept ECF pulp which would harm Södra's sales of TCF.

During 1995, TCF pulp had reached the same quality and brightness as ECF and they were equally good. This was only a few years after the first TCF pulp was introduced on the market. Södra did a lot of efforts to convince the North American market (producing ECF) to prefer chlorine-free paper, but it was a difficult task. At this time when the environmental aspect on the products was still pretty new, the attitude on the market was that companies should not compete in environmental performance, it should be equal for everyone. This has changed dramatically up until today, because environmental performance is a major aspect for companies to compete within to gain trust and market shares. It was not a positive attitude on the market towards this, and thus difficult for Södra to sell their product outside the German speaking countries. The efforts to convince the North American market lasted for four years, between the years 1995–1999, but was not successful, even though a few paper mills started to produce chlorine-free paper, based on Z-pulp. Basically it was the resistance from the North American kraft pulp industry to make the necessary investments for TCF production that was the big obstacle for a TCF market in those countries. The efforts were not facilitated by the fact that in the end of the 1990's it was proved that TCF and ECF, based on modern pulping technology like oxygen bleaching, performed equally well from an environmental perspective. It was no longer possible to prove that pulp bleached with hydrogen peroxide, TCF, performed better than pulp bleached with chlorine dioxide, ECF. Södra had no choice but to give up their campaign and accept that they would be more or less alone producing TCF kraft pulp, whereas the rest of the market continued to produce ECF. At this time more than two thirds of Södra's pulp was TCF and the rest ECF. The chlorine gas used in the beginning, which created dioxins in the environment, was completely phased out in Sweden in 1994.

3.7 The environmental profile was becoming more important

Around the turn of the millennium the interest for TCF pulp was very low, even though the environment was still a hot topic. Focus had now turned towards the forest business where the requirements had become stricter to take good care of the raw material from the forest. The FSC label, Forest Stewardship Council, is introduced. This added an extra dimension to the paper quality once more, because cus-

tomers could now buy paper labeled with FSC. Primarily it was the chlorine-free paper in the beginning of the 90s that added the extra quality factor to the paper and introduced the environmental aspect. Almost a decade later the FSC is added to the paper quality, a label for how well the forest raw material is handled, FSC.

3.8 Investments over a long time-period made it possible to take the lead

Research in the area to use less chemicals in the production and become more environmentally friendly had been going on since early 70s. In total, research lasted for about 20 years, before TCF kraft pulp was on the market. From the public's point of view it might look like only a few years, from the end of the 80s when the debate took off, until 1991 when TCF became reality. But it is in fact only a fraction of the total work and investments made to reach the final product. Thanks to many years of research before the Environmental Protection Agency and Greenpeace began to put pressure on the pulp industry, a lot of work had already been made. That is one of the reasons why the chlorine free pulp could be launched with such short notice, except from the substantial extra investments in the beginning of the 90s that hurried the process.

3.9 Final remarks

Roland points out that TCF definitely has had a positive effect in the long run for Södra. This put Södra on the world map as a progressive company that develops and use environmentally friendly technique. Roland further stresses how the successful outcome from TCF also changed the dialogue within Södra. After the 90s, it became a lot easier to invest in projects related to the environment because of the positive outcome from Z-pulp.

Except from the direct positive effects on the environment from Z-pulp, Södra also saved a lot money when they no longer had to use the same amount of chemicals in the production which was expensive. The new production method was also a lot more efficient which saved energy costs. Other interesting positive side effects from the great investments were that many talented young engineers became interested in working at Södra. Södra became an attractive workplace and they could recruit talented people for further research to become even better. The environmental investments cost a lot of money but might just as well bring many positive side effects that had not been foreseen beforehand.

Roland stresses that care for the environment requires heavy investments. It is expensive to develop new technique and as soon as it is on the market it is easy for competitors to copy at costs much lower than the first-mover experienced. Roland continues and draws a parallel to a pulp mill in Chile that was established some 15 years ago. The new factory could use the latest techniques and was much more energy- and cost efficient. Roland points out that this of course is a good thing when looking at the big picture, because it saves the environment a lot of damage, but it is tough to be the frontrunner.

All in all it is was foremost the market that put most pressure on Södra, whereas the Environmental Protection Agency stated the requirements after the samples showed that the water was poisoned. Later on the Environmental Protection Agency has never required TCF, it has only been a requirement not to use chlorine gas. Since ECF based on pulp with extended cooking and oxygen bleaching has been proven to be

equally good as TCF in environmental comparisons, Södra Cell Värö decided a few years back to quit on producing 100% TCF and instead produce both ECF and TCF in their extended mill, being built at time of writing.

3.10 TCF and the Porter Hypothesis

To relate this to the Porter hypothesis that there could be a win-win effect from taking the lead in environmental innovations, it was definitely a win-win effect for Södra initially. The first years Södra generated extra profits thanks to their chlorine-free pulp, but this slowly subsided as competitors caught up. However, in the long run the effects from this investment and the fact that they were first on the market with TCF has gained additional values other than money. Södra has afterwards been recognized as a company with an environmental quality label. It is difficult to measure the long term value in monetary terms, it is abstract values related to image, reputation and interests from the market. But for a few years Södra's competiveness was definitely strengthened thanks to this new product. The conclusion would be that it is very difficult to retain the competitiveness in the long run, since competitors eventually will catch up, but it can be possible for a shorter period of time, as in this case.

Roland Löfblad confirms in the end that the environmental image has been positive for Södra. Many companies today strive for an environmental profile, including Södra. It is a more abstract value that is not measured in monetary terms, but is still considered worth investing in. Södra has worked hard to keep their image as a frontrunner in environmental technology.

4 Volkswagen, Lupo 3L TDI – when technology was ready but the market was not

4.1 Volkswagen and the Porter Hypothesis

Volkswagen was the first car producer to introduce a car that runs on less than 3 liters per 100 kilometers. It cost Volkswagen years of research and financial investments and was quite a gamble since no one knew how consumers would respond. The car was sold at a price higher than its counterparts, which also contributed to some uncertainty about the market response. EU put up emission regulations, to limit harmful emissions from the car industry during the 1990s, which put a lot of pressure on the industry since the regulations became more challenging to fulfill. At the same time the debate about climate change and the effects from carbon dioxide took off together with greater knowledge on how the car industry affected climate change. Even though demand for cars with less environmental impact was increasing, the market was still not ready to pay for Lupo 3L. This is an example where the win-win effect is not as evident as in the case for Södra Cell. Taking the lead and developing new technology with better environmental performance may not for certain result in a win-win situation for the company. Both the market and authorities play a crucial role.

4.2 Introduction to Volkswagen

Volkswagen was established in 1937 in Germany. Today the Volkswagen Group operates worldwide in 31 different countries around the world. Headquarters are in Wolfsburg in Germany and Volkswagen is today the largest car producer in Europe. The Group consists of twelve brands; Volkswagen Passenger Cars, Audi, SEAT, SKODA, Bentley, Bugatti, Lamborghini, Porsche, Ducati, Volkswagen Commercial Vehicles, Scania and MAN. However, each brand operates as an independent entity. Every day almost 41,000 new vehicles are produced by 592,586 employees.[24] This case will focus on Volkswagen Passenger cars and more specifically on Lupo 3L TDI, a car that did not look promising but later turned out to be the foundation for future fuel efficient technique.

4.3 Lupo 3L TDI – the story

The information below is based on facts from literature supplemented with two different interviews. The first interview was with two representatives from Volkswagen Group Sverige AB – Mårten Blomroos, Manager Legal Requirements and Environment, Vehicles and Marcus Thomasfolk, Head of Communications. The second interview was with Anders Norén, Technical Manager at BIL Sweden since 2007 and former Product Manager at Volkswagen Group Sverige AB. Anders Norén was active at Volkswagen during the time when Lupo 3L was developed and launched.

In 1999 a milestone was reached for Volkswagen when Lupo 3L was introduced on the market. Almost ten years earlier, CEO Ferdinand Piërch, made a promise that Volkswagen would be the first automobile producer in the world to launch a car that runs on less than 0, 3 liter per 10 kilometers before the Millennium. In 1999, the

[24] Volkswagen. (2014).

car no one thought could become reality, Lupo 3L TDI was available on the market. Lupo has turned out to be an important car for future technology and was the best performing fuel efficient car on the market at the time.[25]

4.3.1 The evolution of Lupo 3L

During 1990's the environmental party in Germany, Die Grünen, became stronger and got the power to impact. This raised environmental issues and got more attention than before. Volkswagen wanted to take the lead and show that it was also possible for the car industry to lead by example. This resulted in a diesel car called Golf Ecomatic that was developed in the beginning of the 90s. Golf Ecomatic was the beginning of Volkswagen's green image and also the beginning of Lupo 3L. However Golf Ecomatic did not succeed at all and was withdrawn from the European market before it was introduced in Sweden. Some of the technique used in Golf Ecomatic, like start-stop and the free-wheeling function, was transferred to Lupo 3L. At this time the climate debate had started and regulations on the European automotive industry were getting stricter.[26]

In Europe the automotive industry started to focus on fuel efficient vehicles with decreased carbon dioxide emissions (CO_2). In 1998 the industry had a voluntary commitment that an average car in Europe should emit maximum 140 g/km CO_2 by 2010. It was later replaced by a regulation (443/2009/EU) stating that an average car should emit maximum 130g/km by 2015. This goal was achieved in 2013 and the new goal set for 2021 states that cars should on average emit no more than 95 grams per kilometer. If the goal is not achieved heavy fines and sanctions awaits the industry. Lupo 3L emitted 81 grams per kilometer already in 1999.[27]

4.3.2 The Car

The small four-seat car, Lupo 3L runs on diesel and was a high-technological lightweight construction. Lupo was designed from the former Lupo family except for the fact that about 80% of the old car had been renewed or changed, in order for Lupo 3L to be lighter and more efficient. Intensive research, creative engineering and substantial financial investments were necessary to make Lupo 3L reality. Cost wise the only option was to use an already existing model, because it was too expensive to develop a brand new model. The project started in 1996 and 2 years later 4/5 of the old car had been removed or replaced with lightweight technology. In total the weight had been reduced with 150 kilos and several steel parts had been replaced with aluminium, magnesium or plastic.[28] Lupo can be described from three simple phrases; light weight, low fuel consumption and reduced air and rolling resistance.[29]

The project used a budget of about half a billion D-mark which corresponds to approximately 2.5 billion SEK at the end of the 20th century (Environmental Report 99/00). But the fact that many parts of the old car were removed and never replaced would be very negative for future sales. Lupo 3L, in the base version, lacked a lot of comfort aspects like air-conditioning, automatic window openers and chair heating just to mention a few.[30] Lupo had limited luggage storage, no spare tire and little space for passengers.[31] Volkswagen later wrote in the book Volkswagen 60 år i

[25] Haventon, P (2008).
[26] Norén, Anders.
[27] Norén, Anders.
[28] Volkswagen. (1999).
[29] Norén, Anders.
[30] Haventon, P (2008).
[31] Wedberg, E (2012).

Sverige; *"What is important to remember is that despite a car's environmental appeal, no car that compromised on either comfort or performance (like Lupo 3L) would ever meet with acceptance among customers"*.[32]

During the end of last millennium it was a lot of focus on motor performance and horsepower, whereas this car could not offer any of it. Lupo was all about environmental performance, and was made for people interested in efficient driving, hence the total opposite from high motor performance.[33] However, attention was drawn to Lupo 3L by middle-aged men who drove long distances to work every day. They realized that it was a good investment in the long run because of the low fuel costs. On the other hand Lupo was primarily imported to Sweden to be an excellent car for people working within municipality services. For example helping elderly in their homes requires a lot of short distance driving within the municipality and no need for heavy luggage. Lupo was considered the perfect car and it would be good business for the municipality with reduced fuel costs. This never became a success for services within the municipality though, most likely because of the expensive purchase price which could be difficult to motivate.[34] Lupo lacked cool and interesting features like design and performance and was not considered attractive and exciting on the market.[35] However; except for lack of performance and comfort, Lupo 3L was a big deal in Sweden because it was a diesel car. Diesel cars were not common in Sweden at this time, it was more common in other EU countries. It was a big opposition towards diesel cars because of higher emissions of particles and NO_x. In general a car that runs on diesel is about 30% more efficient than a car that runs on gasoline, and CO_2 emissions are also approximately 20% lower than for gasoline cars. However, as mentioned there are other emissions that are higher which was not popular in Sweden at this time. Less than 2–3% of all vehicles in Sweden were diesel cars at the end of the 90s, which was a very low number compared to other EU countries.[36]

4.4 Expectations before the launch

Volkswagen on the other hand had high expectations on Lupo 3L before the launch in 1999. According to Volkswagen's environmental report published in 1999, analysts had promising hopes for Volkswagens great investment in environmentally friendly technique, such as the Lupo 3L. Analysts claimed that a company that invested in environmental innovation, such as Lupo 3L, can look forward to a successful future in both economic and ecological terms. Hopes were high and Volkswagen was positive about Lupo 3L.[37]

A quote by Ferdinand Piërch commenting on Lupo 3L before it hit the market; *"We have already reached one milestone along this road in the shape of our "3- litre car". In the run-up to the new millennium, the Lupo 3L TDI is the world's first production model to be brought to market with fuel consumption levels of less than 3 litres per 100 kilometres. At the same time, it meets customer demands for high standards of comfort and safety, as well as for low pollutant emissions. We shall be watching the market response to our "3-litre car" with great interest. The Lupo 3L TDI and its innovative engineering represent an important contribution by Volkswagen to safeguarding sustainable mobility for the next millennium"*.[38]

[32] Haventon, P (2008).
[33] Haventon, P (2008).
[34] Norén, Anders.
[35] Haventon, P (2008).
[36] Norén, Anders.
[37] Volkswagen. (1999).
[38] Volkswagen. (1999).

Lupo 3L got most of its attention from people working for the environment, but it never fully reached the public. It was difficult to communicate how it would be economically beneficial to invest more money in a Lupo 3L and save money in the long term from lower fuel costs. People instead complained about the expensive purchase price.[39]

However, people involved with environmental issues highlighted Lupo 3L and the car got many awards for its high performance. For example in 1998, Lupo 3L got the Environmental Award of the Austrian Association of Motorists. Lupo 3L also got the Financial Times Automotive Award in the category Best Breakthrough Product in 1999. It shows that expectations were high for Lupo 3L just before entering the market.[40] In the Environmental Report from 03/04 Lupo 3L is still mentioned as one of the highlights. In the report, the car is for the fourth time in a row announced the winner of Germany's most eco-compatible car, the winner of the German Öko-Trend Institute for Environmental Research and Consultancy.[41]

It was also the first car in the world to fulfill the hardest emission standards in EU at that time (Euro 4). At that time there were tax incentives in Sweden for cars fulfilling Euro 4. It also increased the expectations for Lupo 3L.

4.5 Lupo 3L did not become a success even though expectations were high

Looking back in the mirror, environmental considerations still play a minor role in car purchasing decisions. Unfortunately green cars are still more expensive than other cars on the market, and people tend to base decisions on price. For Lupo 3L it was not to its advantage that it was stripped of comfort and luxury in order to reduce weight, while at the same time entering the market at a higher price than its regular counterpart. Consumers considered it too big of a sacrifice for the environment.[42] Even though Lupo 3L was a small car, it was expensive relative to size. This was of course because of the high environmental performance, but the market was yet not ready to take that into consideration in the purchasing decision. It was rather the wallet that decided the next car purchase, instead of conscience. For small cars like Lupo 3L it is small price margins, since the car had little storage possibilities and was best suited for city driving, the price was considered "too high".[43]

Despite unsuccessful sales Lupo 3L was the beginning of a new era for Volkswagen's environmental image. After Lupo 3L, Volkswagen is dedicated to lead the way in environmental performance and it was the beginning of a new generation of cars. After Lupo 3L, the new series BlueMotion for fuel efficient cars took off and has influenced the image of Volkswagen as a frontrunner in environmental technology.[44] On the last page in the book *Volkswagen 60 år i Sverige* it is stated; *"Volkswagen's core values are innovation power, value for money and responsibility for life and environment that nowadays are more important than anything else".*[45] The environmental appeal has come to infiltrate the whole organization and its way of approaching the market.

[39] Blomroos, Mårten & Thomasfolk, Marcus.
[40] Volkswagen. (1999).
[41] Volkswagen. (2003).
[42] Borup, M and Geerken, T (2009).
[43] Wedberg, E (2012).
[44] Blomroos, Mårten & Thomasfolk, Marcus.
[45] Haventon, P (2008).

Lupo 3L became a buzzword and a trend-setter. Lupo 3L was the beginning of an eco-friendly integrated concept. The new concept was no longer only about fuel consumption but just as much about utilising available technology, selecting appropriate materials and manufacturing processes. Volkswagen meant that if a car consumes less energy in operation but more energy in manufacturing the environment has gained zero. Three stages were analysed to make sure energy consumption was kept as low as possible; energy required for manufacturing, product recycling and energy consumption during use of the vehicle.[46]

4.6 Drive forces to invest time and money in a green car

Expectations from the market as well as pressure from the EU called for action to have less impact on the climate and the environment. Scientists started to communicate how emissions, especially carbon dioxide contribute to global warming. Consumers became more aware on how human actions, like car driving, negatively affect the environment, but the negative effects were maybe not too evident yet, since price weighted more than the environment?[47]

Market pressure was rising but regulations from the EU was also crucial at this time. In 1992 EU introduced a new standard called Euro 1. The new standard put more pressure on petrol-engine cars to perform better. In 1996 a stricter second standard was introduced, called Euro 2. These standards also influenced Volkswagen to change towards more environmentally friendly production to meet the new requirements. In the beginning of the millennium both Euro 3 and 4 were introduced to reduce harmful emissions by fifty percent. The car industry was thus under pressure from both authorities and the market.[48]

Today there are a lot of expectations that fuel-efficient cars should be available on the market. However; both Marcus Thomasfolk, Head of Communications and Mårten Blomroos, Manager Legal Requirements and Environment Vehicles, point out the difficulties that occur when consumers begin to take fuel-efficient cars for granted and are therefore not willing to pay any extra for that kind of car. This easily happens when a technique is considered apparent and producers have a hard time getting paid for the extra amount of time and money spent in research for the new technique. Thomasfolk and Blomroos stresses the importance of clear and strict regulations from authorities to lead the way and ease some of the work for the companies to show consumers the best way forward. Extra benefits for buying a green car could be an efficient way of promoting green cars, but is unfortunately lacking in Sweden.[49] There exists two different premiums for green cars in Sweden today, but the incentives must be stronger. A green car gets five years tax relief which corresponds to about 5,000–8,000 SEK, and if buying a “super green car” the customer gets a one-time “super green car” premium of 40,000 SEK.[50] Extra benefits have proven to be very efficient in for example Norway where electric cars are getting more popular, and help consumers add the environmental aspect in the purchasing decision. Thomasfolk and Blomroos point out the importance of increased benefits for green cars in Sweden as a way forward towards a fossil independent vehicle fleet in 2030, stated by the Swedish Energy commission. Japan is further mentioned as another example where efforts have been made to increase number of modern cars

[46] Volkswagen. (1997).
[47] Volkswagen. (1999).
[48] Volkswagen. (1999).
[49] Blomroos, Mårten & Thomasfolk, Marcus.
[50] Norén, Anders.

with better environmental performance. Japan has introduced a tougher taxation on older cars to make it more expensive to own an old car in order for people to remove them faster. Green cars will instead be considered cheaper in price and running costs. This increases the turnover and green cars will hit the roads faster. This is just two examples where authorities lead the way and help the car industry to improve sales of green cars.[51] Anders Norén, Technical Manager at BIL Sweden and former Product Manager at Volkswagen Group Sverige AB, further stresses the importance of incentives to motivate green cars so that consumers will find the investment worthwhile. The technique is available, but the problem remains that there are not enough incentives and clear long-term goals from authorities.[52]

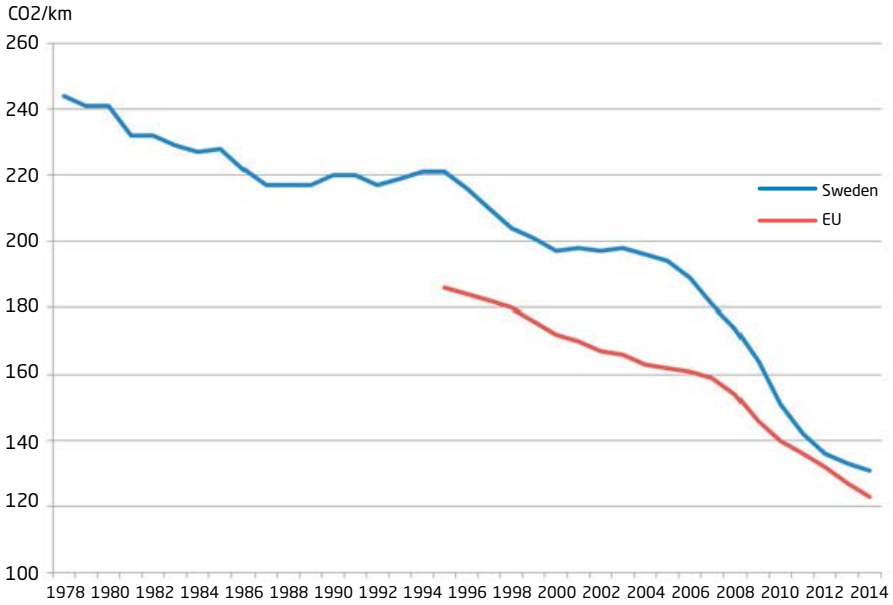
The average car in Sweden is today used for 17 years, which is a long time. Since it is only 15 years left to 2030 when all Swedish vehicles should be fossil independent, the lifespan of a car has to be reduced considerably to achieve the goal. That is why authorities play an important role towards a greener future, to lead the way and make the environmentally friendly choices cheaper. The industry cannot do it themselves.[53]

Because of inadequate customer demand Volkswagen did not launch any successor to the green 3-liter car when the Lupo model went out of production in July 2005.[54]

4.7 Market development after Lupo 3L was taken from the market

A study from 2014 shows that Sweden is the worst in the class when it comes to average CO_2 emissions in Sweden compared to the EU average. In 2014 Sweden emitted on average 130 grams per kilometre, whereas the EU emitted about 123 grams per kilometre.[55]

Figure 2: Average CO2 emissions in Sweden and the EU.[56]

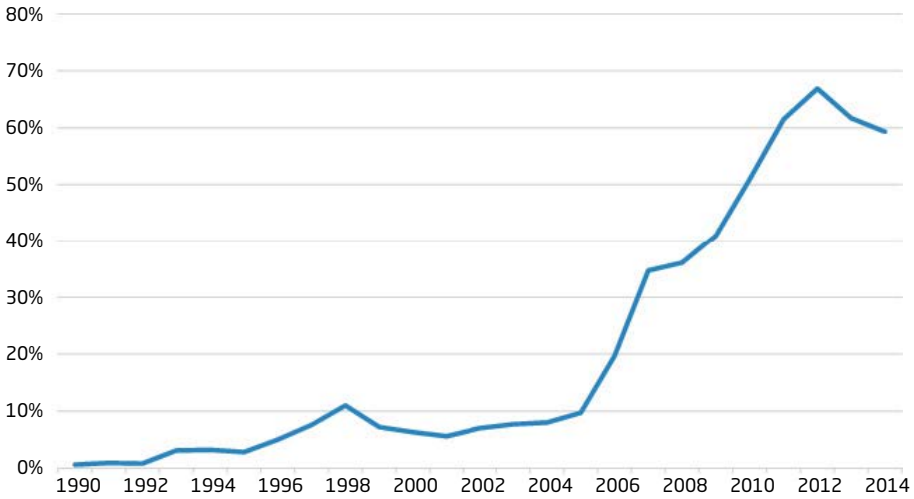


[51] Blomroos, Mårten & Thomasfolk, Marcus.
[52] Norén, Anders.
[53] Blomroos, Mårten & Thomasfolk, Marcus.
[54] Volkswagen AG. (2005).
[55] Norén, Anders.
[56] Norén, Anders. PowerPoint.

Sweden has a history of using large cars that runs on gasoline with higher fuel consumption than the rest of Europe. Swedish consumers are also known for hoarding old cars longer than other countries in Europe, and this trend must change in order to achieve reduced emissions from the vehicle fleet. Safety has for a long time been another important quality factor for Swedish cars, and weight and fuel efficiency have therefore sacrificed for safety. These are two of the main reasons why emissions from Swedish cars always have been above the EU average. The fact that diesel cars were neglected for a long time also explains a lot of the high emissions.

The curve clearly shows how emissions were reduced substantially in 2006 and continued to decrease until 2012. This trend is closely linked to the introduction of a common national definition of a green car, defined by Vägverket in 2007, combined with effective tax incentives. Before the common definition, there were about 40 different definitions of a green car in Sweden, which made it almost impossible for the automotive industry to live up to all the different definitions. However, as soon as Vägverket defined a common definition and introduced a tax incentive of 10,000 SEK, the amount of green cars sold on the market rose significantly, as can be seen from the graph below.[57]

Figure 3: Share of diesel cars on the market from 1990-2014.[58]



Since diesel cars emit about 20% less CO_2 than a gasoline car, number of diesel cars on the roads rose considerably as the new definition was introduced. Along with more diesel cars in Sweden, CO_2 emissions decreased thereafter, as can be seen from the first graph.

When a clear definition was set and a premium for green cars was for certain, the incentives were clear and consumers saw the possibilities of buying a green car. Regulations were well-defined and it was easy for consumers to follow and adapt to more environmentally friendly driving. Nevertheless, in 2012 there was a significant decline in the curve, number of green cars decreased and average emissions in Sweden stagnated. As of January 1st 2013, a new definition of a green car was introduced. The definition was set far too strict which resulted in that almost no car could live up to the new requirements. Since almost no car matched the requirements, the premiums along with the incentives were gone. The policies were badly formed and the

[57] Norén, Anders.
[58] Norén, Anders. PowerPoint.

market response was evident. In 2008 33.3% of all cars in Sweden were classified as a green car, whereas only 4.3% were diesel cars. In 2012 on the other hand 45.3% of all cars were classified as a green car and 30.1% were diesel cars. Just in four years, the proportion of diesel cars rose significantly and the incentives showed positive results. After the new definition in 2013 number of green cars in Sweden in 2013 had decreased to only 10.1% of all cars and solely 5.4% were classified as a fuel efficient diesel car. The statistics clearly shows how regulations and incentives effectively can impact the market and purchasing decisions, both positively and negatively.[59]

4.8 Conclusions and future opportunities

Latest statistics from June 2015 show that the share of green cars has increased again because technology has caught up on regulation requirements. In June, 17.5% of all cars were registered as a green car which indicates that figures are moving in the right direction, even though incentives could be clearer. In 2013, when the green car definition was redefined, the incentives to buy a car with higher environmental performance were lost and almost no car could live up to the new requirements. The price premium was gone because of the stricter definition and the green car trend in Sweden was disturbed. It is important to keep focus to not lose the buyers and continue emission reductions from transports.[60]

According to *System Innovation for Sustainability 2,* environmental considerations are still today believed to play a minor role in car purchasing decisions. Type, price, distinction, colour etc are all considered to be more important. The right financial incentives will be necessary in greening consumers' car choices.[61] Since hopes were high and Lupo 3L was the best performing green car on the market, it is tough when hard work do not bring revenue. Thomasfolk and Blomroos believe Volkswagen acts differently today and is more careful than in the beginning of the millennium. Instead of taking the lead, Volkswagen is today more observant and cautious until the market is mature for new technology. It is considered too big of a risk to be first on the market with new technology.[62]

Sweden has a goal for 2030 to have a fossil independent vehicle fleet, and for 2050 Sweden has a net zero emission goal. Sweden adopts ambitious goals but a lot of responsibility lies on authorities in both Sweden and EU to achieve them. The car industry has set up four guiding principles of how authorities should act in best possible way to reduce climate impact from vehicles:

1. Long term policies
2. Technique neutral green car definitions
3. Support for introduction of new techniques
4. Harmonized regulations within the EU

Anders Norén together with BIL Sweden mean that the net zero emission goal for 2050 should be interpreted as a vision, rather than as a goal. He compares it with the car industry's zero vision regarding traffic accidents and explains the impossibility to have no accidents and just as complicated to measure zero emissions. It is important that

[59] Norén, Anders.
[60] Norén, Anders.
[61] Borup, M and Geerken, T (2009).
[62] Blomroos, Mårten & Thomasfolk, Marcus.

everybody strives for the same vision and it will not be possible solely with regulations – attitude and behaviour are just as important. Dynamics within visions and goals are vital to stay flexible and mobile without excluding any possible improvements.[63]

Average fuel consumption for diesel efficient cars is currently 0.52 litre per 10 kilometres. Hence, Lupo 3L still performs outstanding with its 0.299 litre per 10 kilometres. As former Product Manager at Volkswagen, Anders Norén simply concludes; "Lupo was ahead of its time".[64]

4.9 Lupo 3L and the Porter Hypothesis

To reconnect Lupo and Volkswagen's environmental work with the Porter Hypothesis and the win-win effect, the connection is not very evident. The workload and money invested in Lupo 3L did not match expectations and did therefore not pay off directly. It can on the other hand be seen as an indirect win-win effect. Lupo 3L did not sell as good as expected because it lacked comfort and was a rather expensive car relative to size. Because of low demand on the market, Volkswagen did not introduce a successor to the Lupo 3L when the Lupo model went out of production in July 2005, even though it was highly praised by experts and won many awards for its environmental performance. However; Lupo 3L was the beginning of the environmental profile many consumers connect with Volkswagen's cars today. Thanks to Lupo 3L, a lot of the technique developed for the fuel efficient diesel car has been used and further developed in future cars. Lupo 3L became the start for BlueMotion series and has further deepened the image of Volkswagen as a company working towards a greener future. From that perspective, the win-win effect from Lupo 3L can be interpreted as an indirect positive effect. One single car model turned out to be the start to something bigger than no one at Volkswagen could foresee at the time Lupo 3L was launched.

[63] Norén, Anders.
[64] Norén, Anders.

5 SSAB – How an emission intensive industry can contribute to reduced emissions on a global level

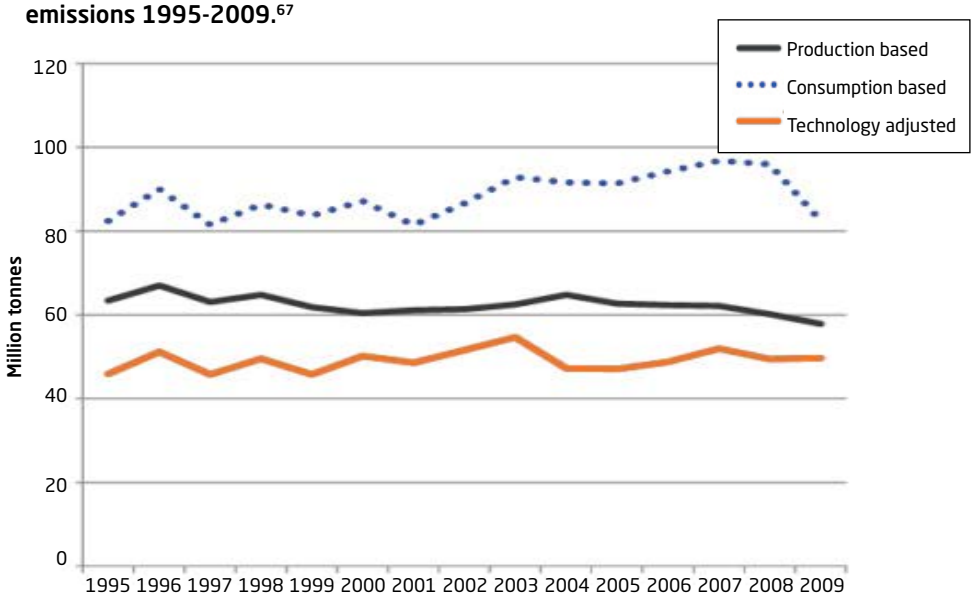
5.1 Porter Hypothesis, Technology Adjusted Consumption Based Accounting and Pollution Haven Hypothesis

Four professors from three different universities claim that production-based accounting (PBA) does not fulfil its true purpose – to report how much each country emits. The UN among others use a method called production-based accounting and does not take carbon leakage into consideration. This model includes emissions from production of goods and services as well as emissions from households within the country. Consumption-based accounting (CBA) is another model that accounts for emissions from production from all goods and services consumed by the country's inhabitants, no matter where emissions occur. That means emissions emitted in China to produce goods for people in Sweden will count as Sweden's responsibility. Emissions per capita with consumption-based accounting will therefore be higher than the production-based system. However, none of these models will fully represent the whole picture. Hence, Astrid Kander and Magnus Jiborn from Lund University together with Daniel Moran from NTNU in Trondheim and Thomas Wiedmann at NUSW in Sydney has created a Technology Adjusted consumption-based accounting model (TCBA). The authors stress the importance of national green-house gas accounting, but that it must be reflected in a fair way. They mean that "actions that contribute to reduced global emissions should be credited, and actions that increase them should be penalized".[65] By using TCBA, trade between countries will be included as well as emissions embedded in the products. The interesting part is if the goods contribute to an emission profit or an emission loss if the goods would be produced on the world market instead. Emissions above the average will increase a country's carbon emissions whereas emissions below the average will decrease national green-house gases. This way of measuring will credit a country like Sweden with a lot of pollution intensive production but produced with energy- and carbon dioxide efficient technology. TCBA will make sure that countries do not reduce emissions domestically at the cost of increased emissions worldwide. This method takes into account what the alternative production could be and hence what total emissions would be if a certain product was not produced in Sweden.[66]

The graph shows Sweden's total emissions with the three different accounting methods. With the consumption-based method (CBA), emissions per capita will be approximately 9 tons. By using production-based accounting instead, as the UN does, emissions per capita are about 6 tons. With Technology Adjusted CBA, emissions per capita will roughly be 5 tons, which is a positive outcome for Sweden and shows that investments in energy efficient technology pays off.[67]

[65] Kander, A et al. (2015).
[66] Kander, A et al. (2015).
[67] Kander, A et al. (2015).

Figure 4: Comparing the three different CO2 accounting measures for Sweden's total emissions 1995-2009.[67]



Another important aspect of the dilemma for emission intensive industries in Sweden is the Pollution Haven Hypothesis. The hypothesis integrates the perspective that dirty industries could be forced to move production to countries with laxer environmental regulations and hence increase emissions on a global level. The hypothesis is further based on the perspective that environmental regulations damage industries because of increased production costs and lower profitability. These kind of obstacles occur for companies competing on a global market when environmental regulations are not neutral. Supporters for this hypothesis claim that pollution intensive industries in regulated economies will tend to move to regions with laxer environmental policies. This could lead to reduced production in countries like Sweden with strict regulations, and harm exports and jobs. This would be devastating for Sweden for two reasons; the Swedish economy will suffer significantly, but foremost emissions will most likely increase globally. If this would happen, there is definitely not a win-win effect to take the lead.[69]

SSAB is one example of several pollution – and energy intensive industries in Sweden. SSAB produces steel and carbon is one of the foundation elements in the production process. It is therefore problematic to reduce emissions after a certain point, which will be examined later on. The technology used by SSAB today is one of the best performing technologies on the market when it comes to environmental performance, but emissions are still 10% of Sweden's total emissions.[70]* This looks bad for national greenhouse-gas accounting, but by using TCBA instead the world leading technology developed by SSAB would be strengthened. This case will enlighten how SSAB contributes to reduce emissions globally and why production must not be forced to move abroad because of unfair competition.

[68] Kander, A et al. (2015).

[69] Dechezleprêtre, A & Sato, M. (2014).

[70] Larsson, Jonas*Share of emissions data from Larsson, Jonas.

5.2 Background to SSAB

Part of the information below is based on facts from Jonas Larsson, Director of Environmental Affairs at SSAB. When referring to the interview, it is Jonas' own words from experience and knowledge about the company and the steel industry.

SSAB is at time of writing the biggest producer of commercial steel in the Nordics. SSAB was established in 1978 after restructuring the Swedish steel industry. The oldest iron plant, Domnarvets Jernverk, was established already back in 1878. In the merge, there were three plants involved, Domnarvets Jernverk in Borlänge, Norrbottens Järnverk in Luleå and Oxelösunds Järnverk in Oxelösund. Today, SSAB has production plants in Sweden, Finland and the U.S. SSAB is active in 50 countries and has approximately 7,000 employees in Sweden.[71]

SSAB produces highly specialized steel and is a leading producer internationally on Advanced High Strength Steel. In Sweden and Finland, steel is produced in a blast-furnace process, which is very carbon intensive. This case will focus on production of High Strength Steel in Sweden and the possibilities to reduce emissions, while competing on an international market with strict environmental regulations from the Swedish government and the EU, controlling business operations.[72]

5.3 SSAB and High Strength Steel

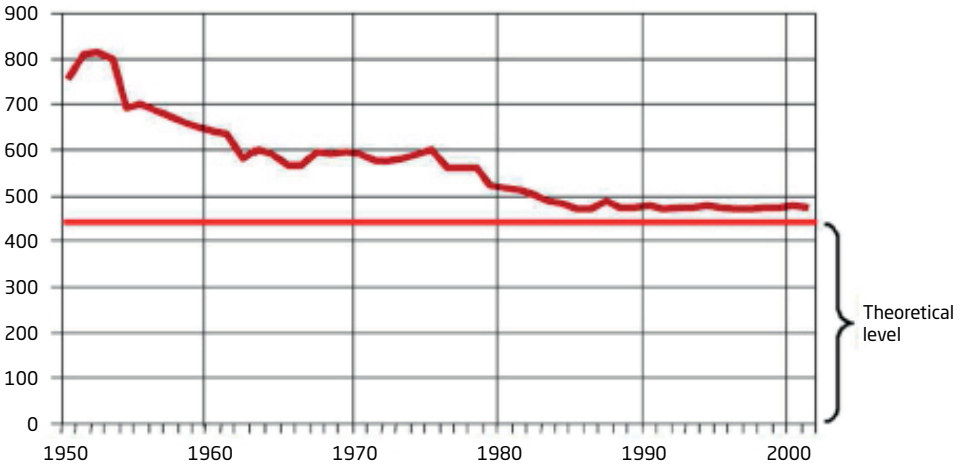
SSAB's vision is "A stronger, lighter and more sustainable world". The vision is built upon the strategy to be the leading company world-wide producing High Strength Steel (HSS). High Strength Steel (HSS) makes it possible to create steel that is lighter and more sustainable in relation to the use of ordinary steel.[73] SSAB is a relatively small operator on the world market and produce about 6 million tons of steel yearly. More than half of the Swedish steel production is done in blast furnaces made from iron ore. SSAB's blast furnaces are among the most CO_2 efficient in the world and produce High Strength Steel with several advantages ranging from a sustainable- to a financial perspective.[74]

5.3.1 The process

Carbon is one of the main components in the steel production process based on iron ore. Iron ore is bound to oxygen, called iron oxide, and by including carbon in the process the oxygen will hang on to the carbon instead and carbon dioxide is formed while the iron is released. With today's technology it is not possible to release iron without carbon. What can and has been done is instead to reduce the usage of coal through efficiency improvements. Since 1950 emissions per ton steel produced has been halved thanks to more efficient production processes. The critical part though is that the theoretical limit on how much carbon that can be reduced is almost reached. Since 1990, the amount of carbon per ton steel produced has stayed almost the same because of the physical conditions in the molecules that is necessary to bind the oxygen to carbon. This condition is illustrated in the graph below, showing the theoretical limit on how much carbon it is possible to reduce with today's technology.[75]

[71] Hynén Ulfsjöö, O et al. (2014).
[72] Hynén Ulfsjöö, O et al. (2014).
[73] SSAB. (2013).
[74] Westerlund, L (2011).
[75] Larsson, Jonas.

Figure 5: The usage of carbon in kg/ton produced hot metal.[76]

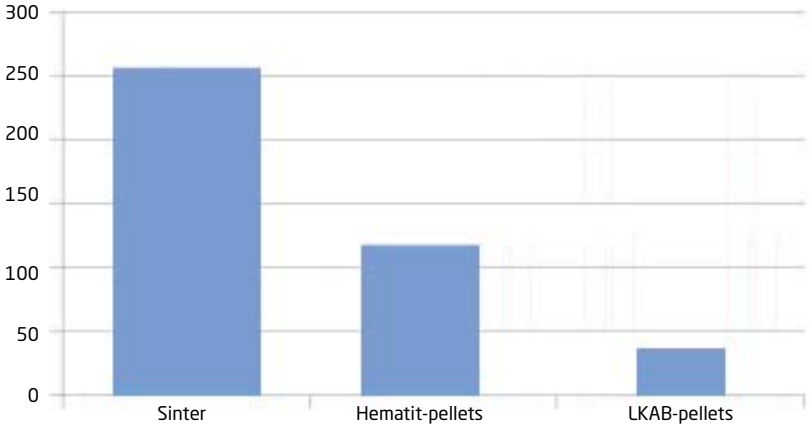


Source: Jernkontoret

SSAB has one of the most efficient steel productions in the world with least emissions per ton steel produced. The blast furnace in Luleå is ranked number one in the world with least emissions per ton produced hot metal.[77]

Thanks to highly specialized iron ore pellets from LKAB, CO_2 emissions has been reduced with 200 kilos per ton crude steel compared to other plants that use different raw materials.[78]

Figure 6: Pellets from LKAB use least amount of CO2 per ton crude steel produced.[79]



Source: www.lkab.com (omritat)

However, with the technology known today it is difficult and even close to impossible to reduce emissions further. A shift in technology will be necessary to be able to make substantial reductions. Future possibilities like Carbon Capture and Storage (CCS) and a shift in production technology could be future solutions and will be discussed later on.[80]

[76] SSAB. (2013).
[77] SSAB. (2013).
[78] SSAB. (2013).
[79] SSAB, Hållbarhetsredovisning. (2013).
[80] SSAB. (2013).

5.3.2 SSAB in an international context

Steel production worldwide emits about 7% of global emissions. SSAB's emissions in Sweden correspond to almost 10% of total emissions in Sweden. Still, production in Sweden is among the best performing in the world; Swedish steel production emits 7% less CO_2 than the rest of Europe, 20% less than China and 30% less than India. If SSAB's production would be replaced with the average European steel mill because of too tough regulations this will only benefit emissions in Sweden, but emissions would increase globally. The global perspective when measuring emissions is therefore fundamental.[81] On average, SSAB emits 1.2 tons of CO_2 per ton steel, compared to the global average that is 1.8 tons of CO_2 per ton steel.[82]

5.4 High Strength Steel

SSAB has decided to develop the business within the scope of High Strength Steel since several decades back. It has been a tactical decision to be more specialized and improve competitiveness. The HSS produced back then is not the same compared to the steel produced today because it is improved all the time, but it was the beginning of a more specialized production process and the advantages were obvious long before the debate about climate change and the environment took off.[83] Today the investments in HSS is an investment in a greener future. Lighter and stronger steel saves both energy and material in the production process, but savings have proven to be even greater in the use-phase of the end-products. Less steel is needed to be produced which reduce emissions, but the biggest reductions of CO_2 are made when HSS is used in vehicles.[84] About 90% of total CO_2 reductions can be derived from the use-phase of vehicles in general. The vehicles become lighter and security is improved thanks to the stronger steel.[85]

A few examples when HSS has shown great results are when weight of a dump truck could be reduced by 8 tons, which corresponds to a weight reduction of 19%, and thanks to lighter trucks the fuel consumption was reduced with 10% by replacing standard steel with HSS. Bo-Erik Pers, CEO at Jernkontoret, the Swedish Steel producers Association, explained how CO_2 emissions within the transport sector can be reduced with 8 tons over a lifecycle if HSS is used instead of ordinary steel.[86] Another comparison between HSS and ordinary steel is that 1.3 million tons of ordinary steel can be replaced with 1 million tons of High Strength Steel. Enormous savings can be made from using HSS, when 300,000 tons of steel can be saved per 1 million ton produced HSS. This corresponds to a weight reduction of approximately 23%.[87]

SSAB incorporates one extra dimension for customers buying HSS. An organization within SSAB called Knowledge Service Centre was established to provide customers with better knowledge on how to maximize the benefits from using SSAB's steel products. SSAB helps constructors with knowledge through this organization and it is quite unique to provide that kind of service.[88] For instance, thanks to Knowledge Service Centre, the Chilean producer Santander Equipos reduced weight on a trailer for beverages by 32% and managed to increase load capacity with 9%.[89] Director of

[81] Larsson, Jonas.
[82] SSAB, Hållbarhetsredovisning. (2013).
[83] Larsson, Jonas.
[84] SSAB. (2013).
[85] Larsson, Jonas.
[86] Pers, Bo-Erik.
[87] Jernkontoret.
[88] Larsson, Jonas.
[89] SSAB. (2014).

Environmental Affairs, Jonas Larsson, believes this has been a great contributor to improve sales and understanding why it is both economically and environmentally beneficial to choose HSS over ordinary steel.[90]

5.4.1 The environmental aspect of HSS

The environmental aspect has become more important for society and has a greater influence in businesses and the approach towards customers. Companies' environmental image is today necessary to meet expectations from the market and fulfil stricter requirements from authorities. Tougher requirements will put more pressure on SSAB and steel production when environmental awareness increases. The great investments in HSS are well in line with tougher requirements and pressure from the market. Resource usage, energy usage and emissions are reduced thanks to SSAB's production process and production of HSS. It is important to see the whole picture and the life cycle perspective to be able to measure the savings made from using HSS.[91] Director of Sustainability at SSAB, Maria Långberg, stresses how important it is to think globally; "When discussing the term *taking the lead* it is important to have the global perspective. We cannot stare ourselves blind on how much Sweden emits, but must realize the climate benefits Swedish technology contributes with internationally".[92]

Another environmental aspect that is important to take into account when trying to measure environmental impact is that steel is 100% recyclable. All steel that is produced can be recycled infinite amount of times which saves both a lot of resources and energy. Steel made from scrap uses less energy than steel made from iron ore.[93] A study commissioned by Jernkontoret, the Swedish Steel producers Association, shows that 50% of the steel production will consist of scrap and 50% will be iron ore, in 2050.[94] Today however, about 20% scrap can be used in the production process in Sweden, whereas the rest is virgin material, since scrap is a scarce resource. The amount of scrap is therefore continuously increasing. It is however essential to point out that if production instead would be based on 100% scrap in Sweden, iron ore would have to be excavated somewhere else, and most likely emissions would increase.[95]

5.4.2 Stålkretsloppet points out the environmental benefits from HSS

A report from Jernkontoret, Stålkretsloppet, has come up with breakthrough research results. The results prove that HSS contributes with more environmental benefits than environmental impact, when looking at a lifecycle perspective. This information is a big step forward in the debate about how the Swedish steel industry impact the environment but still perform among the best in the world.[96]

The Research Programme Stålkretsloppet has been going on for 8 years, divided into 2 four year periods, between 2004 and 2012 and research was in close collaboration with Mistra (Stiftelsen för Miljöstrategisk forskning). The program was sponsored approximately 50% from Mistra and 50% from the Swedish Steel Industry and total cost for the project was 230 million SEK. Stålkretsloppet has been divided into smaller projects to look at new methods to develop better usage of natural resources,

[90] Larsson, Jonas.
[91] Larsson, Jonas.
[92] Långberg, Maria.
[93] SSAB EMEA AB. (2014).
[94] Andersson et. al (2014).
[95] Larsson, Jonas.
[96] SSAB, Hållbarhetsredovisning. (2013).

improved recycling, more efficient energy usage and reduced CO_2 emissions. These results can be used to measure and communicate Swedish steel through an environmental perspective.[97]

5.4.3 The financial aspect of HSS

What is essential for this case is that HSS has not been developed because of environmental regulations but because it saves a lot of money through the whole value chain when making structures with decreased weight and extended lifetime. SSAB decided to invest in HSS in order to survive on the market during a period of high competition and expensive energy prices. During early 80s, substantial efficiencies in the production process were developed and several business opportunities evolved from this. Energy supply was critical in Sweden at this time and nuclear power plants were built to secure energy supply and to become independent from coal imports. This was only the beginning for HSS and has been improved ever since.

HSS can be considered a win-win product since financial investments are lowered and it is a better choice from an environmental perspective because less energy and material is required when less steel is needed in structures without losing its properties. The environmental advantage has grown over time and plays a vital role today when promoting HSS. Customers care more and more for sustainable products and this has been a competitive advantage for SSAB.[98]

5.5 Regulations on EU level and the impact on global competition

SSAB together with 730 other Swedish plants are part of the European Union Emissions Trading Scheme, EU ETS. The steel industry has partly been given emission allowances for free since the industry is highly exposed to global competition from countries that are not part of a trading scheme. The majority of global steel production is in fact not part of a trading scheme. The allocation principle has been altered so that the ones reaching the best European performance level will get most free allocation permits, which has favoured SSAB. For the trading period 2013–2020, free allocations of trading permits have been revised and will sequentially decrease. SSAB claim that the existing system distorts competition on a global perspective and must be reviewed.[99]

5.6 Project involvements for further future emission reductions

Except from research to reduce emissions from blast furnaces, there are other projects that SSAB is part of to support environmental technology innovations. Kristina Branteryd, Environmental Manager at SSAB Oxelösund has in collaboration with the Sports Fishermen Organization started a project called the Pike Factory. The project's projection has been going on since 2011 and the project got clearance to commence in the beginning of 2015. The Pike Factory will boost pikes in the surrounding area in Oxelösund to promote cleaner environment, water and surroundings. The amount of pikes used to be significantly higher and this project will hopefully bring back the original environment and species who lived in the area before the plant in Oxelösund was established. Apart from bringing back pikes to the lake, expectations are that the restoration of the lake will prevent 1.2 tons of nitrogen and 30 tons of phosphorous yearly to reach the Baltic Sea. Hence, the water quality in the surrounding area will improve significantly and results from the first year are already positive.[100]

[97] Sperle, J-O et al. (2013).
[98] Larsson, Jonas.
[99] SSAB.
[100] Branteryd, Kristina.

SSAB is part of a few bigger projects together with other steel operators on the market. Collaboration project ULCOS, Ultra Low Carbon Dioxide Steelmaking, was established in 2004 on behalf of the European Union. The overall goal is to halve carbon dioxide emissions from steel making by developing new technology. SSAB contributes financially and with experts to the project and in total the project has used a budget of €75 million. Over 80 different technologies have been investigated, whereas SSAB has chosen to focus on two of these technologies that are of certain interest. The first and most important project is a pilot plant for a brand new blast furnace developed within ULCOS where carbon is substituted with hydrogen gas.[101]

To support other projects within ULCOS, SSAB is part of three different projects investigating the effects and possibilities to separate and store carbon dioxide, the so called Carbon Capture and Storage technique, CCS. Together with the Swedish Energy Agency and Swedish industry, SSAB play a central role to gain knowledge within the CCS-field. The aim with CCS is to be able to store carbon dioxide in order to reduce emissions.[102] Both Maria Långberg and Jonas Larsson thinks CCS will only be a transition phase before new technique to emit less carbon dioxide is available on the market. CCS is hence not considered a long-term solution, since the common global aim is to become independent from fossil fuel.[103]

5.7 Conclusion

High Strength Steel and its environmental benefits are today fairly well known within the industry and the steel industry works hard to communicate the difficulties to reduce emissions further with today's technology. The strategy to specialise on HSS in the 80s has been positive for SSAB in the long run thanks to improved knowledge and technology that is ahead of other producers. The idea to work in close proximity with consumers has also showed good results. Thanks to Knowledge Service Centre, SSAB has been able to better communicate the advantages of HSS and how to better utilise it in products. Thanks to decades of hard work to reduce emissions and improve resource efficiency, SSAB has built up an image that is more environmentally friendly than many other companies in the business. Projects on the side like the pike factory, CCS and ULCOS all contribute to build up the image of SSAB as a company who works towards a greener future. Time, money and employees invested in research and innovation is a proof of great interest and true dedication to become more environmentally friendly.

The difficulty SSAB together with the rest of the steel industry stand in front of today is that regulations are today focused on emissions from the actual production process, instead of measuring emissions by using a life cycle assessment. Emissions are reduced thanks to world leading technology in the Swedish Steel industry and the production of High Strength Steel, it is just not accounted for in national greenhouse gas accounting.

Demand for High Strength Steel is high and SSAB has a positive attitude towards the future. The tight spot is however to find new technology to be able to reduce CO_2 emissions further. Stricter regulations from the EU that could aggravate production and threaten the industry within Swedish- but also European borders are also uncertain for the future. Global warming will not be positively affected from moving production abroad because of too expensive production in Sweden.

[101] SSAB. (2013).
[102] SSAB. (2013).
[103] Långberg, Maria & Larsson, Jonas.

5.8 High Strength Steel and the Porter Hypothesis

Is High Strength Steel correlated with a win-win effect as Porter defines it? The question is a bit ambiguous because it depends. High Strength Steel is a highly specialised steel and SSAB is one of the world leading producers, which gives a competitive advantage. 1.3 million tons of ordinary steel can be replaced with 1 million tons of HSS. This saves both energy and resources and is beneficial in both financial and environmental terms. This is a win-win effect as Porter describes it and clearly shows how investments in resource efficiency and cost savings lead to improvements for the environment. However, Porter claims that a win-win effect is achieved through "well-designed" policy instruments and it is successively stricter regulations from authorities in Sweden and the EU that is risking the future business for SSAB in Sweden. Regulations hit hard on pollution intensive industries like SSAB, and emissions are strictly measured in the production process rather than over a life cycle. When an industry or a company is forced to shut down production and move abroad, because of too strict regulations, the policy instruments cannot be considered "well-designed", if it results in increased emissions globally. There is no win-win effect in this scenario.

To relate back to the recent research on greenhouse-gas accounting and Technology Adjusted CBA (TCBA), SSAB is a clear example of how technology improvements must be highlighted in the accounting method. TCBA can finally prove that Swedish investments in greener technology contributes to reduced global emissions. HSS is resource- and energy efficient and therefore contributes to reduced global emissions from a lifecycle perspective.

6 Discussion

6.1 Is it profitable both economically and competitively to "take the lead" for Swedish companies?

None of the three discussed cases developed an environmental profile because of policies and regulations from authorities. All three companies; Södra Cell, Volkswagen and SSAB, developed products with improved environmental benefits thanks to market pressure, consumers' power and an inner force to become more resource- and energy efficient. This has resulted in environmental savings and perhaps, it has been an anticipation of possible future regulatory demands and a desire to be prepared, come what may. Well-designed regulations are in the above mentioned cases, not influencing decisions and workload dedicated to better environmental performance. To relate back to a paper written by Runar Brännlund and a sentence describing the foundation of the Porter hypothesis, cited in the beginning of this paper; "…//companies per se are inefficient and incapable of finding the inefficiencies themselves, but need strict regulations to achieve it". This paper rather proves the opposite when looking at three different industries during different time periods, and show no direct evidence of more green products as a result from regulations in the above mentioned examples.

6.2 Innovation or regulation

The causality dilemma is commonly stated as "which came first; the chicken or the egg"? Was it the innovation that came first or the regulation? It is in fact the innovation or the technique that usually comes first and policymaking then follows with policies supporting good innovation. The role for politicians is not to invent new technology, it is the companies' role on the market. It can be misleading to regulate too early before any consequence analysis is conducted for the reason that regulations might otherwise prohibit other technique to be developed, commonly referred to as technique neutrality. Policymaking and regulations impact indirectly because there is an underlying understanding that better usage of resources will be a political desire to develop a more sustainable society. The threat from global warming is growing and politicians can contribute to combat climate change through regulations when best available technique is on the market and there is a clear positive outcome. Therefore, regulations should not prevent first movers to take the lead and prohibit any technique before it is fully examined – instead it should be a tool to bring on the last movers to adapt the new technique. Indirect impact from politics can be good impact or when regulations can encourage a certain technique without harming other options. As in the case for the green car definition in Sweden that was explained in the section about Volkswagen. The green car definition had a lot of influence in what kind of car consumers chose. The car purchase trend in Sweden for the last twenty years clearly shows when the definition and incentives were designed properly and when it was misleading and not fully incentivized consumers to choose the green car. For this kind of development, policies have great power to influence, to lead the way and cooperate with the producer, in this case the car industry. It is however important to keep technique neutrality, use the regulation tool wisely without preventing any ideas from entering the market. The example about the green car definition in Sweden shows how important it is to set regulations with a long term perspective.

6.3 Is there a win-win effect?

From a Porter perspective there is no "win-win" effect to be found in this paper; that regulations contribute to research and development that in turn will come up with environmentally friendly technology and improve both international competitiveness as well as economic growth. However, there is an evident "win-win" effect from market pressure and development within green technique. Consumers' demand combined with an inner force within the company to become more efficient and better usage of resources does trigger innovation and reduces the environmental footprint on a global level. It can be a win-win effect for companies aiming at taking the lead in environmental innovation, as can be seen from the above mentioned cases. The brand image for all three companies examined grew thanks to investments in green technology. Furthermore, all three companies also experienced improved market shares. Regarding market shares it is however a matter of time; for Södra Cell it was more evident initially and then faded over time, whereas for SSAB the market shares grew over time. For Volkswagen, Lupo did not increase market shares directly but the technology that was developed was probably one important factor when the BlueMotion Series later was introduced. Hence, it is necessary to stress the risk regarding the right time for a product with high environmental performance to enter the market. The amount of research needed and foremost when the market will be ready for the new technology or products. Volkswagen used ten years to create Lupo 3L, but it must not be forgotten that the previous car, Golf Ecomatic was a big inspiration and a lot of knowledge from that car was transferred to Lupo 3L. For Södra together with the Swedish forest industry, the research took more than twenty years to develop the TCF technology. But from society's perspective it looked like Södra only needed the last few years to change technology due to crucial environmental alarms such as dioxins in crab. There were a lot of pressure on Södra because of attention from both media and Greenpeace at the time. SSAB has improved the High Strength Steel since the 80s and it is thanks to decades of research and knowledge-building that has brought SSAB to the position they are at today. Enterprises are in general taking a great risk when investing in new technology but foremost when trying to take the lead.

6.4 The willingness-to-pay dilemma

Another issue discussed throughout the paper is the willingness to pay for products that are more expensive but incorporates environmental benefits. It is behavior and mindset for human beings that is hard to change but nonetheless necessary to change in order for new products to enter the market. It is natural to pay more for new products, a great influence is also if there is a short term or long term thinking. The wallet often decides in the end, when the environmental perspective should be weighed in, because it will be less costly in a long term perspective to choose green products. Södra Cell managed to charge a higher price for the TCF pulp the first five years, then the premium was gone, and SSAB today gets better paid for High Strength Steel than standard steel. However; for Volkswagen it was more challenging to convince consumers why the more expensive green car was a better choice both financially and environmentally, than the less-green car. The producer often perceive a difference in willingness-to-pay if the product is sold directly to the end consumer or business to business (B2B). From the examples described through this report it seems to be easier to charge a higher price if the product is sold B2B, like SSAB and Södra Cell. For Volkswagen on the other hand, who sells cars to the end consumer, it was challenging to sell a green car at a higher price. It is an interesting perspective that it could matter who the buyer is, if it is B2B or B2C, but it is not possible to draw any conclusions

from these results. However, the purchase price does matter and is usually higher for green products, therefore it is of importance to change the mindset towards a long term perspective in order to understand the true value in a life cycle perspective. More sustainable products that last longer, produced with an environmental outlook through the entire production process will create greater environmental benefits and be part of the future.

6.5 What about the second-runner?

The question then arises: Is it maybe more profitable to be the second runner instead of being the frontrunner? It is evident in the example from Södra Cell that kraft pulp mills built after the 90s, when TCF- and ECF pulp technology was established, saved both time and money since the hard work was already made. In the case about Södra Cell, there is an example from Chile, a kraft pulp mill built in the beginning of the 21st century with the latest technique at a lower investment cost. Södra's success was a result from many circumstances that could not be affected solely by Södra. Swedish companies established and active in a small country like Sweden but still operating globally, can experience a difficulty to penetrate the international market with new environmental technology. Companies in Sweden are operating under regulations from both the European Union and separately for Sweden, while at the same time managing with international competition. It is not an easy equation to solve, but as it appears from this paper, there are examples of when companies manage to balance the equation and find it profitable to invest in green products and technique. There is a proactive mindset within most companies in order to survive. A proactive business intelligence together with structured and carefully performed effort plays an important role to stay on top with better competitiveness and retain a strong link between the brand and environmental performance.

7 Conclusion

Four main conclusions can be drawn from the above discussed topics.

1. It is important that society put up incentives and objectives over a long term perspective while using a life cycle assessment to obtain the true benefits and costs from products and services.
2. The three cases examined do not show any evidence of following the Porter hypothesis. Companies rather have their own driving force to become more resource efficient and beneficial for consumers and society as a whole. The inner driving force in turn leads to new products with higher environmental performance and shows the way forward. It was the ability among enterprises to change plus the knowledge building within environmental- and resource efficiency that created the new technologies discussed through this paper. There is an indirect pressure from politicians within the environmental field but it was not regulations that pushed the changes. Regulations seem more and more to be put in place in order to catch slackers and the Porter hypothesis gives the impression to be ancient.
3. The technology adjusted consumption based accounting method (TCBA) makes it for the first time possible to measure the environmental performance from companies´ products. The new method could open up the possibility to measure resource- and energy efficiency in order to lower the environmental footprint, since it could be possible to compare over time and among countries and industry sectors.
4. Lastly it is essential to stress that being a frontrunner in any area is for the company a risky decision. There is no difference if the risk is due to technology with high environmental performance or any other new technologies entering the market.

8 References

Alfredsson, E & ten Berg, H & Wannefors, J. (2013). Miljöpolitiska styrmedel och företagens konkurrenskraft - återbesök hos Porterhypotesen. *Tillväxtanalys*. 22.

Andersson, G & Axelsson, H & Eriksson, R. (2014). Metallutredning 2014. *Jernkontorets Forskning*. D860. 2

Bingel, E & Sjöberg, C (2003). *From Defensive to Proactive*. Stockholm: Alfa Print. 54.

Blomroos, Mårten; Manager Legal Requirements and Environment, Vehicles & Thomasfolk, Marcus; Head of Communications at Volkswagen Group Sverige AB. 2015. Interview 22nd September 2015.

Borup, M and Geerken, T (2009). *System Innovation for Sustainability 2*. Sheffield, UK: Greenleaf Publishing Ltd. 7-17.

Branteryd, Kristina; Environmental Manager at SSAB Oxelösund. 2015. Visit at SSAB Oxelösund 3rd September 2015.

Broberg,T & Hammar, H & Marklund, P-O & Samakovlis, E. (2010). Does Environmental leadership pay off for Swedish industry? - Analyzing the effects of environmental investments on efficiency. *National Insitute of Economic Research*. 119.

Brännlund, R & Lundgren, T. (2009). Environmental Policy without Costs? A Review of the Porter Hypothesis. *International Review of Environmental and Resources Economics*. 3.

Brännlund, R. (2007). Det kostar för svensk ekonomi att driva en tuff miljöpolitik. *Göteborgs-Posten*. Available: http://www.gp.se/nyheter/debatt/1.123222-det-kostar-for-svensk-ekonomi-att-driva-en-tuff-miljopolitik. Last accessed 9th Dec 2015.

Dechezleprêtre, A & Sato, M. (2014). The impacts of environmental regulations on competitiveness. *Grantham Research Institute on Climate Change and the Environment & Global Green Growth Institute*.

Haventon, P (2008). *Volkswagen 60 år i Sverige*. Hässleholm: Norre Skåne Offset. 121-132.

Hynén Ulfsjöö, O & Leidefeldt, P & Wasteson, E. (2014). Börsgruppens Analysgrupp, SSAB. *Linköpings Universitet*.

Jernkontoret, (2012). Miljönytta med höghållfasta stål i fordon. Stål Formar en Bättre Framtid. *Jernkontoret*.

Jonsson, H & Lemne, C & Torwaldsson, K-P. (2015). *Sex punkter för framtidens svenska klimatpolitik*. Available: http://www.dn.se/debatt/sex-punkter-for-framtidens-svenska-klimatpolitik/. Last accessed 4th Nov 2015.

Kander, A & Jiborn, M & Moran, D & Wiedmann T. (2015). National greenhouse-gas accounting for effective climate policy on international trade. *Nature Climate Change*.

Larsson, Jonas; Director of Environmental Affairs at SSAB. 2015. Interview 26th October 2015.

Långberg, Maria; Director of Sustainability at SSAB. 2015. Seminar 23rd October 2015.

Löfblad, R. (2004). The development of clean technology in bleached kraft pulp production at Södra Cell, Värö Mill. *Södra Cell AB*.

Löfblad, Roland; Former Environmental Manager at Södra Group. 2005. Interview 1st October 2015.

Naturvårdsverket. ( ). De Svenska Miljömålen. *Naturvårdsverket*.

Norén, Anders. Powerpoint from BIL Sweden. 2015.

Norén, Anders; Technical Manager at Bil Sweden since 2007 and former Product Manager at Volkswagen Group Sverige AB. 2015. Interview 21st Oct 2015.

OECD. (2015). Do Environmental Policies Affect Global Value Chains? A New Perspective on the Pollution Haven Hypothesis. *OECD*. 13, 10-27.

Pers, Bo-Erik; CEO Jernkontoret. 2015. Seminar 6th Oct 2015.

Sperle, J-O & Sperle Consulting & Hallberg, L & Almemark, M & Lindors, L-G & IVL & Andersson, G & Ekdahl, Å & World Steel & Larsson, J & Johansson, B & SSAB EMEA & Johansson, H. (2013). Miljövärdering av stål och stålkonstruktioner – Handbok för ingenjörer, forskare och högskolestudenter. *MISTRA & Jernkontoret*.

SSAB EMEA AB. (2014). Miljörapport 2014 Borlänge. *SSAB*.

SSAB, Hållbarhetsredovisning. (2013). Hållbarhetsredovisning 2013. *SSAB*.

SSAB. (2013). Vitbok - SSAB och koldioxidutsläppen. *SSAB*.

SSAB. (2014). Mot Branschledande Lönsamhet - Årsredovisning 2014. *SSAB*. 11.

SSAB. *Handel med utsläppsrätter.* Available: http://www.ssab.com/sv/Hallbarhet/Miljo-och-klimat-/Handel-med-utslappsratter-/. Last accessed 5th Nov 215.

Södra Cell. (2013). *Södra Cell.* Available: http://www.sodra.com/sv/Om-Sodra/Vara-affarsomraden/Sodra-Cell/. Last accessed 4th Nov 2015.

Södra Group. (2013). *Södra Cell.* Available: http://www.sodra.com/sv/Massa/Vara-massabruk/. Last accessed 5th Nov 2015.

Södra Skogsägarna Ekonomisk Förening. (2015). Uppförandekod. *Södra Skogsägarna Ekonomisk Förening*.

Wedberg, E (2012). *Stora Guiden om Volkswagen*. Denmark: Bonnier Tidskrifter. 68-69.

Westerlund, L (2011). *Stålboken*. Borlänge: Henningsons Tryckeri AB.

Volkswagen AG. (2005). Sustainability Report 2005/2006 - Moving Generations. *Volkswagen*.

Volkswagen. (1997). The Lupo - Design and Function. *Self Study Programme No. 201*.

Volkswagen. (1999). Environmental Report 1999/2000. *Volkswagen*.

Volkswagen. (2003). Environmental Report 2003/2004. *Volkswagen*.

Volkswagen. (2014). *TheGroup.* Available: http://www.volkswagenag.com/content/vwcorp/content/en/the_group.html. Last accessed 4th Nov 2015.

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