



Interview study of conditions for zero emissions in Swedish basic industry

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Introduction

In this report, the results are presented of the interview study and subsequent focus group discussion we held in the scope of the research project *Green Industrial Transitions* (GIST, www.gist2050.com). The research project's main objective is to study the conditions for a transition to zero emissions of carbon dioxide in Swedish basic industry¹ and analyse strategies, measures and policy instruments that can contribute to a green industrial conversion.

In autumn 2016, we held 30 semistructured interviews with individuals active in industry, politics, authorities and trade associations, who were selected to represent the entire sector in an accurate manner. We have anonymised the interviews as it contributes to the interviewees being able to be more free-spoken. The interviews were allocated in the following manner: 7 interviews with representatives from industrial companies, 6 with representatives for the industry organisations in the steel, mining, chemicals and forestry sectors, 7 interviews with authority individuals, 4 with politicians and 6 with trade associations (environmental organisations, trade unions). In total, we interviewed 34 people, of which 21 men and 13 women, since more than one person participated in some interviews. All interviews were recorded and transcribed and were then analysed using the qualitative data processing program NVivo.

We presented the interview materials in an initial version of the report with the aim of describing the general impressions that came forth in a systematic review of the interview responses regarding basic industry's position, societal governance, actor and gender relationships, as well as opportunities for basic industry to transition to zero emissions in the long term and regarding the role of societal governance in such a transition. We worked out the interview material by searching for patterns in the responses. We searched for certain words and terms and paid attention to how they were discussed. The first version of the interview report was sent to everyone who participated in the interviews and some other persons who we were in contact with in the course of the study. At the same time, they received an invitation to participate in a workshop focused on the interview results.

On 4 October 2017, a half-day workshop was held with interviewees and other invitees to discuss the results of the interview study. Besides giving us an opportunity to confirm our interview results, most of the time at the workshop was devoted focus group discussions on some key issues that the interview study gave rise to. This gave us an opportunity to deepen our analysis and further develop the results. Eleven people participated in the workshop, of whom eight had participated in the interview study and three were new.

In this final version of the interview report, we chose to structure the presentation of the results in accordance with the interview questions we asked (for the interview template, see the appendix). In Chapters 1-6, we summarise the results from the interviews in six main themes. Each chapter is concluded with the question the results gave rise to that was discussed in the focus groups. The results from the focus group discussions are presented in

¹ In our study, we use the term Swedish basic industry to refer to the energy-intensive and raw-materials-based material and process industry active in the iron/steel, mining, chemicals and forestry sectors.

Chapter 7. The report presents the interview results without further interpretations and analysis, which will be done in a later phase of the study.

We would like to thank everyone who participated in the interview study and the subsequent workshop. We also welcome comments and opinions regarding the report. The report authors can be reached at the following e-mail addresses:

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1. The significance of basic industry to Sweden, historically, today and in the future

In a new report on the conditions for zero emissions in basic industry² we confirmed that basic industry has been a foundation for Sweden's welfare and economic development. We wanted to know if this agreed with the perception among our interviewees and asked the question: How do you view the significance of basic industry to Sweden? Everyone essentially agreed that basic industry historically played an invaluable role for the Swedish economy and the development of the welfare state. All of the interviewees seemed familiar with the term basic industry. At the same time, many thought it was problematic to speak about basic industry in general since the conditions and the challenges differ widely between the various industrial sectors included in the broader definition of basic industry.

As many as 22 of our 34 interviewees expressed the view that Swedish basic industry will have an important role in the future as well and in the climate transition even if it is difficult to predict exactly how. The development of basic industry is affected by the demand for various basic materials and changes in the raw materials base, issues which in turn depend on technical and market development. While many feel that it is a problem that basic industry no longer has a strong base in society, there are nonetheless favourable conditions that mean that most of the respondents see the basic industry sectors as givens even in an economy with (almost) zero emissions of carbon dioxide, especially in a global perspective. There is no doubt that Swedish basic industry possesses a materials and process technology know-how that Sweden has good use for even in a low-carbon future.

Weaker base in society

Many respondents believe that the relative significance of basic industry has decreased markedly over time and point out such factors as the trade balance and employment rate. The products exported are of decreasing significance to the Swedish economy and basic industry is perceived as "old fashioned" compared with other important export industries, such as the music and gaming industries. Basic industry is seen by many as something of a speed bump in the climate work because of traditional industrial structures that are difficult to transform in purely technical and systems terms.

From the basic industry having had a given position and having been well rooted politically and in society, many feel that the attitude to basic industry is more negative than before. The respondents reflect quite a bit on why development is going this way: It is because the population no longer has a given connection to industry. Young people do not know what it means to work in the industry and business leaders in industry are no longer celebrities. The metropolitan perspective is dominant, meaning there is a lack of awareness about industry's significance or circumstances. It is mainly in the rural areas where the raw materials are available that the basic industries exist and stand for employment and in various ways contribute to vibrant societies. It is mainly in rural areas that basic industry has created jobs and generates income for its subcontractors. Local politicians and residents in these cities are, however, often well aware of and familiar with the significance of basic industry to the

² Johansson and Nilsson, eds., (2017). *Nollutsläpp i basindustrin – förutsättningar för en ny industripolitik* [Zero emissions in basic industry – prerequisites for a new industrial policy], Lund University, Environmental and Energy System Studies, Report number 101.

city and region, which for example is expressed in the following quote: “it’s kind of hard to imagine Sandviken without Sandvik”.

In the interviews, it is also pointed out that there is a knowledge problem, i.e. a difficulty in understanding the industrial processes and raw materials management in basic industry. The sceptical attitude towards basic industry today may be about knowledge of basic industry not reaching out. Many do not know for example how forest and wood raw materials are used in the forest and pulp industry and even if steel exists everywhere, people have no direct relationship to steel. The knowledge problem may be due to slow transformation processes not fitting into prevailing media logic or basic industry not succeeding in marketing itself in relation to climate issues.

Change potential in basic industry

However, many of the interviewees, especially those who represent the industry, were convinced that there is a strong change potential in the basic industries and that most of the basic industries will continue to play an important role in the Swedish economy. The will to change is about “finding a way to combine reduced emissions with good retained competitiveness”. Swedish industry being efficient and having low emissions is an important basic prerequisite and competitive advantage. One respondent talks about there being “a very strong, industrial and technical tradition in this country” and industry having an ability to renew itself and develop new solutions to maintain competition and innovative strength. Another claims that for “basic industry to survive, it must always be on the forefront of research and development”. In Sweden, we are well advanced, the idea is that the companies “sort of become niche players, mainly the iron and steel industry” and make high-quality products not in bulk, but with an emphasis on quality, such as using sustainable raw materials for sustainable products.

Another example comes from the forest sector, which expresses a very strong belief in the future, through its investments “in existing production chains” and with research and innovation in new products and new production methods for the future. Another respondent believes that “a materials revolution in the world” is under way based on nanotechnology, which means that Swedish industry can make “even smarter, better, stronger materials” that provide major development opportunities, primarily for the chemicals industry, but also for the iron, steel and metal industries.

The energy system and the rich supply of quality raw materials are a strategic advantage for basic industry and enable renewal. Especially electricity production’s low carbon-dioxide intensity plays a major role as demands for climate performance increase. As one respondent explains it, it is relatively obvious that if it is “clean electricity into a smelter, the emissions will be a lot less” and that it is much better to use smelters in Sweden that have a very climate-efficient electricity mix than facilities in countries that use diesel-driven generating sets and petroleum and carbon based electricity.

Another strength for the competitiveness of basic industry in relation to climate targets and sustainability is the relatively well-developed system perspective, the circular economy, with a strive for efficiency enhancements along the whole value chain, and here recycling and recirculation of materials is key. But, as one business representative emphasizes, how the climate transition is handled can be what defines basic industry’s justification for existing in

such a future. From such a perspective, the climate transition is a boundary condition that offers strategic possibilities for Swedish industry.

Discussion question: What significance does basic industry's changed position in society have for its possibilities for climate transition?

2. How does climate governance of basic industry work today?

In the interviews, we asked a number of questions about what the societal governance looks like today and how the interviewees feel that it works. An important conclusion is that EU ETS is seen as the most important policy instrument even if nobody thinks it works optimally. A broader, more active societal governance of basic industry is wanted. Many also discuss the problem that basic industry works in a global market and the limits that this sets for what governance is possible.

EU ETS is the most important policy instrument

From the interviews, it comes forth clearly that the EU system for trading in emission allowances (EU ETS) is perceived as the most important policy instrument for regulating basic industry's emissions of greenhouse gases.³ More than half of the respondents clearly mention EU ETS as the answer to the question of what characterises societal governance today. Many of the interviewees believe that EU ETS basically has potential to function as a good policy instrument and believe that it will probably remain the main policy instrument for a long time to come. However, several respondents think that EU ETS does not work optimally today, but suffers from major problems. There are two conflicting pictures of EU ETS: on one hand that it does not give a strong enough steering signal and on the other that it entails an excessive pressure on basic industry's financial conditions.

Seven of the respondents, mainly from authorities, politicians and trade associations, feel that EU ETS does not have any appreciable steering effect on the industry's emissions today. These interviewees believe that the emission ceiling has to drop and that free allocation to industry must end in order to get the price of emission allowances to increase. This view ties into a general perception among several respondents that the governance of basic industry is based on protecting industry from international competition and giving it the best conditions possible, mainly through exemptions from climate policy instruments like carbon dioxide tax and electricity certificates and in the form of free allocations of emission allowances.

In contrast to the perception that EU ETS is too weak, respondents from industry organisations and companies say that EU ETS can negatively impact the companies' competitiveness. This is particularly true of the steel industry. The respondents also feel that the price signal will never be enough to reduce process emissions since there is currently no technology to change to. An excessively stringent allocation of emission allowances would instead risk leading to the process industry not surviving financially. Other kinds of policy instruments are needed to develop new technology. If the financial conditions for the companies of the steel industry are worsened, there is, if anything, a risk that they will not be able or dare to be involved in long-term investments to develop new technology.

³ Other economic instruments mentioned, although to a limited extent, are national economic instruments, such as the carbon dioxide tax, the electricity certificate system and environmental permits. Basic industry is heterogeneous and for some sectors, the Swedish economic instruments are less relevant, while for example the forest industry is affected to a large extent by the electricity certificates.

A broader governance of industry is sought

A persistent response from many respondents in all categories is that broad governance is needed to implement a conversion to very low emissions in basic industry. The price signal is not enough to achieve a change. Instead, other efforts are needed to stimulate new technologies. The respondents seek a more proactive governance of basic industry on the part of the state, with a mix of carrots and sticks. Several of the respondents from trade associations and companies say that there is a shortage of this kind of governance today.

Other measures sought are a clear political vision for how the bio economy should develop, support for innovations to reduce the risk of demonstration projects, and to reduce the commercial risks through new financing possibilities. The respondents from authorities feel that there is a desire in industry to reduce their emissions and demand for policy instruments that offer economic incentive for change, such as demonstration facilities, creation of niche markets, or public procurement of green products. One respondent highlights that there is sometimes a mismatch between different steps in the government control of innovation and technical development. Policy instruments that focus on research, technical development and demonstration can be under way for a long time, but then policy instruments are missing to bring about commercial facilities on a larger scale when the technologies are ready for it.

One respondent discusses why there is a lack of a more proactive governance of basic industry and feels that an important cause may be the negative experiences of industrial policies from the 1970s and 1980s that lead to a fear of pursuing an active industrial policy. According to the respondent, there is an aversion on the political side to making major decisions on technical choices, which would be needed if investments in technical development are to be made on a large scale. When the question comes up in the Government Offices, “they don’t even want to talk about it, it’s like at that level that they fall silent. They don’t want to at all.”

Problems working in a global market

Representatives from industry organisations and companies highlight problems of them working in a global market while steering take place on a Sweden and EU level. Most would prefer to see a global system with the same carbon dioxide prices for all companies. According to some respondents, the level of the carbon dioxide price would not play such a large role in this situation and could even be a competitive advantage for Swedish industry. Several respondents emphasise that Swedish industries are among the best from a climate perspective and that the best climate policy would therefore be to improve the conditions for Swedish basic industry so that it can be expanded and replace production in other countries. Industry is said to support a transition to low emissions, but it must be done without threatening competitiveness. Policy instruments must therefore be formulated so that the changes do not lead to higher production costs in a global world.

Some respondents take up the risk of “carbon leakage” and believe that if it becomes too expensive to produce because of higher climate surcharges, it can lead to the industry closing down, moving out or making new investments in other parts of the world. However, two respondents are more critical about the argumentation that industry would move abroad if climate policy becomes too tough. They believe that the risk is often exaggerated in industry’s argumentation and that there has historically not been a particularly large relocation abroad due to environmental regulation, but rather the move abroad has mainly been due to other

factors such as lower wages. One respondent highlights the carbon dioxide tax as an example of an economic policy instrument that was first opposed by business, but in hindsight has been cited as an example of a successful policy instrument that contributed to Swedish industry having much better climate performance than competitors in the rest of the world. The respondent believes that this situation can also arise for new policy instruments that entail higher demands on industry.

Discussion question: How can EU ETS be developed into a functioning policy instrument for a climate transition of basic industry, and how does EU ETS relate to national policy instruments in Sweden?

3. The central actors and their role in a climate transition

In the interviews, questions were asked about who the most important actors are in terms of influencing the environmental and climate efforts of basic industry, and what the relationship looks like between different actors. The companies and trade associations of basic industry as well as the state and politicians are mentioned as the most important actors. The relationship between the state and industry is described as characterised by dialogue and collaboration even if they do not always agree on what governance should look like. However, concern is expressed by industry of a lack of understanding among authorities and politicians of the conditions of industry.

Industry and the state are the most important actors

Most of those interviewed believe that the companies themselves are central to a transformation of basic industry. Politicians and authorities in Sweden, as well as the industry's trade associations were also mentioned by most respondents as important.⁴ Several respondents discussed the interaction between industry and politics both in terms of who the driver of the development is and what the division of responsibility between these actors should look like. Several respondents among authorities and politicians believe that it is the companies' own driving force to change that is most important and that the industry bears the main responsibility for a change taking place. Respondents from trade associations and companies also believe that an independent driving force from industry is necessary and that measures must take place on commercial grounds. At the same time, many of those interviewed believe that industry and politicians have a shared responsibility and that cooperation is therefore needed between these two groups of actors. There are different perceptions of what role the trade associations play. Representatives from business believe that the role of the trade organisations is important to influence politics, both in Sweden and on an EU level. Some of the other respondents from authorities, politicians and environmental organisations believe that the trade associations, both in Sweden, but mainly in Europe, are more reactionary and oppose measures to reduce basic industry's emissions.

Collaboration and dialogue mark the relationship between industry and state

A large part of the respondents say that the relationship between industry and politicians/authorities is largely characterised by dialogue and collaboration and that collaboration is something to strive for. Dialogue and collaboration between state and industry is perceived as a strength and relates to the Swedish model both today and historically. Some respondents exemplify how it has historically been used in the development of new technology, such as in telephony (Televerket/Ericsson) and electricity systems (Vattenfall/ASEA), but also note joint research programmes between state and industry as contemporary examples.

⁴ A number of other actors (environmental organisations, unions, research, customers) are mentioned by those interviewed, but none of them are mentioned to a particularly great extent. The EU and its institutions are mentioned as important by only four respondents which may seem surprising since EU ETS is perceived by most to be the most important policy instrument for the climate work of basic industry.

Another aspect of the relationship between state and industry is dialogue in the structuring of new policy instruments. Both industry representatives and authorities provide a similar picture of the interaction as a mix of formal participation in reference groups and hearings and more individual meetings with industry representatives. Industry's representatives believe that it is important for them to be able to provide their picture of the effects of various policy instruments and influence their structure. Some of the corporate representatives believe that they need to be very active to monitor new policy instruments and submit input in the policy process. The respondents from authorities are generally positive to a developed dialogue and one official expresses it as follows: "For us, it's certainly important to have a dialogue and I think it's mutual. I think that we need to understand what needs to be done. It's an important part to be able to achieve the goals set in society." However, the respondents emphasise the need for a balance between the open dialogue and the neutrality of authorities and officials. "Of course, it's important for us in my opinion to be neutral, which means being civil servants in this too. So that's why it's important that we have procedures."

Good experience of the Environmental Objectives Committee

Several of those interviewed have experience of being involved in the Environmental Objectives Committee and mention it as an example of a good dialogue between various actors. According to one of the politicians, the Committee was important since all political parties took part, as well as representatives from business and other interests. According to the politician, it was agreed that the transition had to be successful at the same time that industry remained competitive and there was a consensus that the financial issue had to be solved. One respondent from a trade association expressed a similar view. This respondent had the impression that the Committee's participants, and all of the political parties, understood that the companies are not ignoring the climate issue, but that they are facing tough challenges and need support to be able to make the shift. Another respondent highlights the importance of creating trust between companies and government authorities and see the Committee's work as a positive example of this. The respondent express it in the following way: the first half of the year was about increasing the level of knowledge of all participants so that they had a good understanding of the problems, then they were able to begin working to create a shared vision and think about different solutions. It was "incredibly strategic to work that way". However, not everyone had an undividedly positive view of the Committee's work. One respondent perceived it as a problem that business representatives had an excessively strong influence and functioned as veto players when ideas or solutions were presented that they did not approve of.

Poor understanding of the conditions of industry

Some respondents say that it is a problem that politicians have poor knowledge about the conditions of industry and lack personal experience of industrial activities. One respondent says that there are fewer politicians today than before who have their own experience of industry and that they therefore lack a personal understanding of how political proposals affect companies. It is partly about acting in a global market and what governance is then possible, but also about how individual policy instruments affect industry and that decision-makers do not always see the whole picture of a policy instrument's effects on industry. This is why knowledge transfer is seen as a prerequisite for a mutual dialogue and this is an important part of industry's communicative strategy.

Discussion question: What changes in the relationship between different actors would be needed to support a climate transition in basic industry?

4. A male dominated industry with a need for competent women



Basic industry has been a strongly male dominated sector. We discussed this in 26 of the interviews and a majority, 17 people, agreed with this statement. We asked our interviewees to reflect on male dominance and if and how basic industry has changed in this respect in recent years. Interesting insights regarding the significance of equality to recruitment and basic industry's future development came forth in the interviews.

Male dominance

Many interviewees perceive basic industry as “very masculine and very patriarchal” and believe that there are therefore very few women in leading positions in basic industry. It is a historically male environment built on the mines and steel being tough and hard environments that have demanded male labour and “the further into industry you go, towards heavier industry, the more male dominated” it becomes. The steel industry, the chemicals industry and large parts of the forest industry have this nature and it applies from the board room to the floor, but basic industry is not seen to be different than industry otherwise. The dominance of male bodies has led to a special culture in an industry that is “very traditional in nature”. The respondents who spoke about male dominance in basic industry felt that it was a problem as it influences how the operations are run and perceived. Several point to differences between men and women’s “different ways to look at things” and explained that when it is only men, the male thinking tends to dominate, which means that a very large group has been excluded and “perspectives that should of course be there” are then also excluded. In other words, basic industry is only provided “information that is held within a circle of old men”, which is not seen as good for “development and critical thinking” and a problem for companies as it limits the competence that is supplied to basic industry.

Changes in the direction towards equality

A minority (four people) felt, however, that it was less interesting to discuss male dominance in basic industry. They focused instead on women’s visibility in basic industry: There are “quite a few women in the sector” such as SCA’s facilities in the Sundsvall area, which have female managers and several paper mills, pulp mills and sawmills with female managers. There have always been women present. There was for example a woman rolling mill manager in Hällefors who was very skilled, but our respondent says, she as well as the other pioneers “behaved like men” since that was how one made progress in the industry. But this is different today since the companies are working hard to increase the proportion of women.

Working for equality is a deliberate choice and a strategy for change in several of the sectors and businesses of basic industry. It is partly for symbolic reasons that it is perceived to be a strength to “have a woman as the face outwards” and it becomes important to be able to present women in different positions in the company. The image of Swedish industry internationally is that of innovative thinking, which includes equality and the environment. But the motives are not just symbolic, but rather there is at the same time, among some a strong confidence in what a higher percentage of women can contribute.

Women add different competence

It is asserted that women are important for basic industry since they work in a different way. Women try to “find solutions all the time” by “networking and talking and getting together all of the actors and getting everyone in the group”, a touch that is sought after in the change that basic industry is in the midst of. More women add a dynamic way of working, according to one respondent who says that it is always a “much better dynamic in the discussion when both boys and girls are included”. This leads to a higher creativity, which in turn leads to higher productivity. Among the respondents, there is a strong belief in women’s special expertise as a strong contribution to basic industry and as support for this, they bring up the proportion of women on the research and development side, such as product developers, which is constantly growing. It will influence which innovations are developed.

Several respondents were sceptical to whether there were clear differences between the sexes that could be of use to industry while others pointed out that women can add energy and resource-saving gender-specific competencies. One example is that of women crane operators, which was claimed to be “an area where women are known to be better than men”. Women crane operators have “a tendency to do it softer and more thoughtfully and somewhat less aggressively” and “cranes are that kind of thing, you can jerk up a load or you can do it under control”. The same is true of heavy vehicles, “there are of course many who can bear witness to the maintenance cost on a truck run” in the mines and then “it is clear that things have a tendency to last longer if it is women who are driving”. Another respondent uses the Aitik mine outside Gällivare as an example: “They have very, very large work machines that run the ore up from the open pit mine to further processing and they have had less maintenance and better fuel economy on their large dumpers when they have more women drivers than men”.

Need for competence for the future

For the future of basic industry, the issue of gender appears to be less about equality or what differences can be leveraged, and more about the need for skilled personnel. Several respondents highlighted women’s high level of expertise relative to men, where women dominate in the best educational programmes with “a trend of more and more women in the engineering programmes”. Industry must harvest this expertise, if not “then we are really in a bad situation” and it is therefore crucial that there are actually enough women who are interested in the steel industry, for example. The women are still a small part of the workforce and there are distinct difficulties in recruiting women regardless of the ambitions. An important prerequisite for basic industry is that there is a supply of expertise and the possibility to attract labour. For this to be possible, the image that it is a male dominated industry, or that only “old men” work there, must change.

Discussion question: What is the significance of gender equality to the climate transition of basic industry?

5. Zero emissions in basic industry: opportunities and challenges

At the end of the interviews, we asked questions about the respondents' view of opportunities and challenges to achieve (near) zero emissions in basic industry in the long term. The main impression is that perceptions of the climate issue and the challenges it entails for basic industry are well-established among the business representatives we spoke with. The interviews indicate an awareness among respondents that industry's emissions need to decrease radically in the long term and what types of solutions may be required. Industry representatives show readiness to discuss issues related to the basic industry's climate challenges and the need for strategies to achieve zero emissions in the long term. This is clearest in the steel industry, but also among representatives from the other industrial sectors, such as the forest industry, petrochemical industry and cement industry. Among political decision-makers and officials, zero emissions in basic industry appears to be somewhat of a new issue. The interview responses indicate a reasonably good understanding of industry's conditions among political representatives and public authorities, but at the same time they emphasise industry's own responsibility to make the change. Political representatives say that they in recent years perceived an attitude change so that the same kind of thinking about the climate challenge that is in the political sphere also exists in the process industry. The steel industry's steel-without-coal vision, or that the petrochemicals industry says that they work with 'molecules rather than petroleum products' is an expression of this.

An important insight is that Swedish basic industry is heterogeneous and that the challenges, and technical possibilities, consequently look different for different sectors. *The forest industry* stands out and is considered to have particularly good conditions to make the transition considering the forest raw material and the growing bio economy. The industry is now undergoing a structural transformation as a result of reduced demand for newsprint, while other areas of use such as hygiene products and packaging are growing. The forest industry highlights the large emission reductions they achieved in recent years, so much that their internal processes are largely already fossil-free today. The paper and pulp industry's carbon dioxide emissions arise only to a limited extent in the actual industrial process, but rather are largely related to energy use and transport where possibilities to use renewable energy, as well as residual products and residual heat are good. On the part of the forest industry, the climate benefit of active forestry is also held up, which, however, is a complex and debated issue related to the effects of land use on the carbon balance.

The steel industry accounts for around one tenth of the Swedish emissions, of which around 90% originates from the use of coal in the blast furnaces while rolling mills and smelting plants as well as internal transports account for the remaining emissions. Within the steel industry, CCS was long seen as the main alternative for reducing the process-based emissions. Industry representatives say that time has run away from the CCS technology even if it may be needed in some industry sectors, especially the cement industry. During the work of the Environmental Objectives Committee on a new climate policy framework, the Swedish steel industry changed its position and began promoting hydrogen gas for direct reduction of iron ore as an alternative to carbon in today's blast furnace, a technical shift that is said to have the potential of reducing the steel industry's emissions by more than 90%. Since the

HYBRIT project was launched, as a joint initiative between SSAB, LKAB and Vattenfall, it has achieved broad attention both within and outside the steel industry.⁵ While some express scepticism about technical development and profitability, many industry representatives are hopeful or enthusiastic about the steel-without-coal initiative, which they see as an opportunity to cut the main part of the steel industry's climate impact and at the same time solve the industry's problem of a higher share of intermittent energy. The project offers, as one representative from another industrial sector put it, the possibility to "use the inexpensive zero-cost electricity when the wind is blowing to convert it into hydrogen gas and then use the hydrogen gas as a reductant instead of carbon". But this presupposes novel thinking; "industry does not like wind power because it is intermittent... but imagine if we could use it intermittently instead". Interviews with the actors involved confirm that the initiative came about after some novel thinking in the companies regarding electrification and the possibility to balance Swedish electricity distribution by having output to hydrogen gas production. Another advantage of the steel-without-coal initiative is that the CCS technology does not appear as optimal for the Swedish steel industry at the same time that efforts to change the process technology are associated with lower political risks; "the political risk is less in these primary measures than in the secondary" as one respondent expresses it.

For *the petrochemical industry* and for the plastics industry, a switch of the raw material base to more bio-based materials, as well as circular flows are held up as interesting development opportunities. Such development is motivated in these industrial segments not just by the climate issue, but is also driven by ambitions to change over to a biobased circular economy. In terms of biobased products, industry representatives point out that quite a bit is happening on the innovation side while solutions remain to be developed for functioning circular flows on the plastics side, e.g. in the form of mechanical recycling or chemical recycling on a molecular level in "return refineries". For example, in the Stenungsund cluster, five companies have started the Sustainable Chemistry initiative as a development cooperation with Chalmers University of Technology on industrial symbiosis and development of petrochemical process technology. For the *cement industry*, however, CCS still appears as the main technical alternative for handling the process emissions that come from cement production (removal of carbon dioxide from lime combustion), at the same time that the need for fossil input energy can still be replaced by renewable energy or residual products. In the *mining industry*, the ambitions of becoming climate neutral are mainly about electrification (electric vehicles, battery operation, automation), fuel cell power or a transition to fossil-free fuels. And Boliden has had plans of developing zero emission operations in the Lavergruvan mine, but after the rejection for a processing permit from the Mining Inspectorate, it remains to be seen how the ambitions can be developed further. Another example is LKAB's iron ore pellets that reduce carbon use in the steel industry.

Altogether, many industry and sector representatives are hopeful about the possibilities of achieving near zero emissions, as long as they are given conditions to streamline their processes and develop new process technology. From political and union camps and among authority representatives, both uncertainty and cautious optimism are expressed about the possibilities for the process industry to transition to zero emissions. The climate transition is

⁵ Since our interviews, the HYBRIT project has been granted R&D support by the Swedish Energy Agency, among others, and this summer, SSAB, LKAB and Vattenfall formed a joint venture company to drive the continued development of the steel-without-coal initiative.

seen as both a strategic opportunity for Swedish industry and a chance to show the way for others through pioneering. At the same time, difficult industrial challenges (technical, financial, commercial) remain to be addressed in these sectors to develop strategies to promote a conversion to carbon dioxide-free industrial processes. This may apply to both development and investments in new process technology and a transition to new raw material bases or development of CCS technology to capture and store carbon dioxide that arises in industrial processes. Such challenges are considered by most to justify some form of involvement from the political arena, both in terms of research to support development of technologies and system know-how, and structurally to manage financial and market risks of such technical shifts.

Discussion question: What change processes in basic industry can contribute to zero emissions in the long term?

6. The role of societal governance in the transition to zero emissions

The questions about opportunities and challenges were followed in the interviews by questions about how societal governance should be formulated to support basic industry to convert to (near) zero emission and what the state can do to guide such a conversion. The main impression from the interview responses is that both industry and business representatives, as well as public representatives see a need for more active societal governance to achieve the changes required.

Better dialogue and collaboration

Firstly, more dialogue and collaboration between state and industry is wished for to establish a mutual understanding of the challenges presented to industry by a climate transition. Industry representatives seek a more dynamic understanding of the conditions of industry and prerequisites to change its processes, both in terms of industry's capital investments and long investment cycles, as well as the competitive situation that many basic industry companies are in. Here, the Environmental Objectives Committee's proposal on strategic programmes for basic industry are welcomed, but for industry, it remains to be seen how these programmes will be developed and by whom. Examples of expressions for this are seen to be the government's assignment to the Swedish Energy Agency regarding innovation promotion efforts to reduce the process industry's emissions of greenhouse gases (N2016/06369/IFK), as well as the new industrialisation strategy's emphasis on smart industry and sustainable production. The state's industry council and the Government's industry dialogues are appreciated by industry representatives, but for the climate transition, as one business representative puts it, what is needed is something of a "handshake between different actors ... like between the state and the steel industry". Others see a need for sector targets or sector roadmaps.

The art of strengthening societal governance without overly stringent control

Many interviewees express a need for a reinforcement of societal governance, but at the same time, some industry representatives express concern about the inability of politicians to let things alone. The role of politics is seen to be to set out the direction, such as by establishing long-term climate targets like in the Paris Agreement or in the climate policy framework, and to create conditions for industry's change work. But, as one business representative put it, the state should avoid micromanaging: "what's the long-term goal, that's what the role of politics should be...I think that an important part is that the state shouldn't steer too stringently, but rather that it actually looks at what the long-term goal is, that we want to have a carbon-dioxide neutral basic industry and then there may be different ways forward." This speaks for a societal governance that is clear in its emphasis, but flexible and adaptable to changes in the surrounding world, new technologies and knowledge development.

Here, the interview responses seem paradoxical to some extent. On one hand, general economic policy instruments (CO₂-price, emission allowances) and clear, long-term rules are wanted that in the best of worlds would be globally adapted. The global dimension is important considering that industry is subject to competition, and many believe that the Paris Agreement will be of major significance to lifting the climate ambitions of other

countries. But none of the interviewees actually seem to believe in uniform international carbon dioxide prices in a foreseeable future. On the other hand, it is seen as necessary that the political sphere supports industry in its climate transformation since individual industries lack the ability to bear the investments on their own or to take the risks that such a transition entails. At the same time, politicians need to prioritise between which different efforts resources are devoted to. This indicates that the politicians are facing something of a governance dilemma; how can politicians give clear signals on direction and goals and create conditions for industry's climate transition without micromanaging technical development and the choice of technologies or risking getting stuck on a certain kind of solution?

This relates to the complexity of the industrial ecosystem and indicates a broader overall view of the function and role of societal governance to promote technical development and support industrial transformation. Several people therefore assert that societal governance needs to work with both push and pull factors, as one authority representative puts it. Others see more system thinking and understanding for the conditions of industry and the systems individual processes are a part of. This in turn presupposes that "one looks at the whole... that one creates good conditions for technical progress, that there are clear targets, that there is a credibility in the targets and that one has both of these push and pull factors."

In more concrete terms, push measures are highlighted in the form of more support for research and development and test and demonstration facilities, which go beyond pull efforts in the current innovation policies or in the form of today's climate policy instruments for carbon dioxide pricing. Other policy instruments brought up, concern the supply of capital and risk sharing (e.g. state guarantees and investment support), infrastructure investments or placing requirements in public procurement regarding climate-efficient technology and to continue to develop EU ETS. Few want more regulation of basic industry even if industry representatives admit that legal requirements can work just as well as policy instruments as long as they are consistent and long term. Many also point out how earlier regulations in the environmental area pushed Swedish industry to both improve its environmental performance and increase its productivity, which contributed to industry being well prepared when environmental requirements increase in the rest of the world. Others are doubtful if it is possible to come much farther that way and some even believe that it would be a mistake to direct more surcharges on industry where the resources are instead needed to develop new process technologies to achieve important technical leaps.

The role of the state – supporting industrial development and sharing the risk

The state's role is seen by many as significant to support industry's development and virtually essential for a climate transition of basic industry, especially to create conditions for the technical shifts necessary. As one industrial representative puts it: "no structural conversion has occurred without any political involvement at all, rather everything has been driven by political decisions when we electrified Sweden, when we expanded nuclear power". Interviewees highlight several factors that motivate a more active state involvement, such as the long-time horizons and the major risks that are associated with industrial development and investments, as well as industry's vulnerability to global competition. A climate transition presupposes the development of technology that, as yet, is not commercially viable, or the technical shift where there is a lack of solutions in part or in whole. "There is no supplier I can call and ask to order a new blast furnace that does not release any carbon

dioxide at present” as one respondent expressed it. Industry’s own drivers in the form of demand for new materials, high-quality products, competition and price pressure are present, but rarely give enough incentive for changes that go beyond continuous efficiency enhancements and the constant strive for productivity improvements. Industry also encounters environmental requirements from customers and other stakeholders, but as the rules and climate policy governance look today in the surrounding world, it is often hard to justify investments in new, climate-efficient process technology on commercial grounds. Here, both industry and authority representatives consider it to be important that the state gives industry support in the development phases and for strategically important, but risky efforts.

The question is how much risk the state should take and how politicians should decide between different technical investments. Even if it is a shared responsibility between state and industry, many interviewees point out that the state has a responsibility to share the risk if such investments are to be brought about at all. This is especially true of technical shifts, without which some industry segments would probably not make much more progress in reducing their emissions. As one industry representative puts it, ultimately, it is about “reducing the risk in demonstration and pilot projects... and sure, reducing the risk in commercial, semi-commercial projects... I believe that significantly more money must be invested than is done today”.

At the same time, the interview responses show that the perceptions of the stages in which and manners in which the state should come in and support industrial development are as yet somewhat undeveloped. While some talk about support for basic research and in early stages of development to lay the foundation for technical leaps, others point to the significance of support also in the up-scaling phase from lab scale to full-scale demonstration facilities. From both the industrial and political spheres, it is emphasised that policies in Sweden are relatively good at supporting research and development, but worse at supporting demonstration and commercialisation to scale up to an industrial scale, which can be explained by the focus of innovation policy to-date on early stages of development. Other obstacles that are mentioned are the EU’s competition and government subsidy rules that limit the possibilities for the state to financially support individual company projects, or that support for large demonstration projects does not fit into the energy research’s existing budget limits, but rather must be financed with contributions from elsewhere, such as the EU Innovation Fund. Besides supporting research, demonstration and technical development, another important task for the state is to take responsibility for infrastructure issues, such as electricity distribution with a higher percentage of intermittent electricity distribution, or the infrastructure surrounding production, storage and distribution of hydrogen gas.

Industrial policy or strategic investments in industrial development?

Some interviewees highlight needs of a more active business or industrial policy, while others back away from questions about a new form of industrial policy. At the same time, many talk about a need for strategic efforts in industrial development in areas important to the Swedish economy or, which offer possibilities for Swedish industry to be on the forefront. This is a bit contradictory, but is an expression for the term “industrial policy” in a Swedish context still being associated with earlier attempts to save the shipping and textile industries in the 1970s and 1980s, a policy that was broadly perceived as ineffective and failed. Nobody wants to go back, but many, including industry and business representatives, point to a need to support

industry in the development of new technology, sustainable production and climate-efficient processes, a need that goes beyond general innovation policy support or economic policy instruments, such as the pricing of carbon dioxide emissions. The state is considered to have an important role in supplementing such governance with support for research, development and demonstration and strategic investments in industrial development. Here, some interviewees believe that one can discern a change since the change in Government in 2014: “there is a more strategic view of manufacturing and industry compared with the former government, which put more focus on innovation in more general terms”. At the same time, many believe that the Environmental Objectives Committee’s work contributed to a broad consensus about industry’s challenges and the terms for industry’s climate transition.

In an industrial policy perspective, the Swedish energy system is also pointed out as a competitive advantage, where the Nordic electricity production’s low carbon dioxide intensity is seen as a competitive advantage as requirements on climate performance are growing in the rest of the world. This can contribute to attracting foreign investments and new corporate establishments in energy-intensive industry sectors, such as computer centres, battery technology or nano-cellulose. We already see examples of establishments by foreign investors who view Sweden as a climate-efficient country.

Discussion question: What concrete political measures are needed in the short and the long term to support basic industry’s climate transition?

7. Results from focus group discussion at workshop on 4 October 2017

On 4 October 2017, a half-day workshop was arranged where we presented the preliminary results from our interview study. We organised focus group discussions to talk about the six key issues the interview study gave rise to. Eleven people participated in the discussions and were divided into two groups. Every group had a chairperson who was responsible for leading the discussion and passing the floor and a reporter whose duty was to summarise the discussion and briefly convey it to the others. The researchers were observers and did not participate in the discussion. Results from the focus group discussions are presented below.

Question 1. What significance does basic industry's changed position in society have for its possibilities for climate transition?

There was a consensus in the groups that it is central that basic industry is seen as an important and visible industry by both decision-makers and the public to give support for political prioritisations for a transition of industry. The participants also discussed there being an inaccurate image of basic industry being antiquated and marginal in Sweden, because this is not the case.

One of the groups brought up that it is not only the position of basic industry that is important, but also its attitude, and the view was expressed that a major change has occurred in basic industry's view of the climate issue, its own responsibility and possibilities to implement a transition, in a much more positive and proactive direction.

Another issue that was brought up was that one must realise that it is not just basic industry that has a responsibility for the carbon dioxide emissions of material production, but also the companies who use the materials produced by basic industry. Accordingly, greater focus is needed on the entire value chain and on the significance of the product. In connection with this, discussions were also held on the need to realise that a conversion of basic industry is the responsibility of the whole of society. The climate transition can also be linked to other efforts in electrification and digitalisation, bio-economics and the circular economy, where basic industry has an important role.

Question 2. How can EU ETS be developed into a functioning policy instrument for a climate transition of basic industry, and how does EU ETS relate to national policy instruments in Sweden?

There was a consensus in both groups that EU ETS cannot in itself contribute to the technical development needed to achieve zero emissions of greenhouse gases in basic industry. In one group, it was emphasised that EU ETS is a policy instrument that is intended to provide cost-effective emission reductions and incentives for fuel changes, and that the system has delivered in that capacity. However, it is not suited to contribute to technical leaps, but rather other supplemental policy instruments are needed for that. The EU Innovation Fund was also discussed and there was an opinion in the groups that the funds are inadequate to support technical development, which is why other measures are also necessary.

One problem that was brought up with EU ETS is that it has included wide variation and fluctuations in the carbon dioxide price, which has created uncertainty in the market. While it was asserted that the price signal needs to be strengthened, the participants agreed about what came forth in the interview responses, namely that it is doubtful if the price on emissions allowances will drive basic industry's transition in the long term. The system is formulated to promote cost efficiency and stimulate fuel changes, but not to drive important technical leaps for which other policy instruments are needed.

A number of supplementary policy instruments and policies were discussed. "Industriklivet i Sverige" [Industrial Strides in Sweden] was mentioned as an example of possible supplementary policy instruments to support industrial transition. Another example is to nationally introduce a floor for the price of carbon dioxide with the aim of keeping the price from dropping too low, and it was pointed out that Germany and the UK, for example, have such floor prices. Another discussion concerned questions about punitive duties (or BTAs) to protect the competitiveness of industry if national measures are taken. The Swedish attitude to counter such a development was recommended in the groups since free trade is of greatest importance to basic industry, and especially in an increasingly uneasy world.

Question 3. What changes in the relationship between different actors would be needed to support a climate transition in basic industry?

In one group, the discussion was focused on the relationship between industry and the state in various ways. The view was expressed that industry has an important role to clearly explain and describe what is possible to achieve since it is otherwise very hard for politicians to decide on various policy instruments.

Both the Environmental Objectives Committee and the Energy Commission were highlighted as good examples of collaboration between politics and industry, and of broad political agreements between the parties in the Swedish Parliament. An advantage of the Energy Commission pointed out was that the discussions are held behind closed door, and not in full view, which enabled a freer discussion and that people were not locked into set positions. According to one comment, there were parties who seemed to be very far from each other at the beginning, but where one would move closer together after the discussion.

A strategy to not get stuck in political discussions on issues that are hard to agree on is to lift them out of the discussions to be able to reach agreement in other issues. Then these issues can be lifted back in again to try to address them. Examples were provided from the Food Strategy, and perhaps what concerns nuclear power in the Energy Commission.

In the group, it was expressed that there is an expectation today in industry that one should go further politically after the Environmental Objectives Committee with more concrete measures and roadmaps for the various sectors of basic industry. There is an expectation of a close and continuous dialogue about what is to be done and at what speed. Today, there is a common vision, but more dialogue is needed on the policy instruments. It is also believed that there are tendencies for a closer dialogue.

One idea that was presented was to have an industry vision for transition or a Zero-emission vision for industry. Another was a clearer bio-economy agenda or vision.

One suggestion was that a mediator may be needed between state and industry who is neutral and can listen to both parties to propose measures and policy instruments. In Norway, the industry side went together and appointed a negotiator on the climate policy and specifically on CCS. There is also close dialogue between the state and industry there.

Another issue that was brought up was how to move on from the broader political agreements on long-term goals to political collaboration surrounding policy instruments and policies. Emphasis was placed on the need for political unity because it concerns long-term processes and major investments. An example is the issue of the Industry Strides initiative and if it has been discussed with the political opposition and supported by it. One reflection was that a climate policy framework is now in place, but that it does not say anything about the policy instruments needed. Instead, this is being left to the officials in the Swedish Governmental Offices.

In the other group, discussions were largely about the relationships between different companies and industry sectors and it was expressed that collaboration is needed not only from the companies of basic industry, but also companies higher up in the value chain and closer to the consumer, such as car makers and construction companies. This is needed to make it profitable to invest in products that have lower emissions of greenhouse gases. The finance industry was also mentioned as an important actor and a greater awareness of the risks of investing in carbon dioxide-intensive industries and companies is necessary.

An important question that was brought up in both groups was that of risk sharing since no individual actor can take the whole risk for the large and uncertain investments needed. The risk sharing issue concerns the division of responsibility between state and industry, as well as what role the state should play. In this context, the EU's government subsidy rules were discussed and what the state can do. The perception was that one can be given an exemption and that it need not be a problem. Norway was mentioned as an example of a country that drives a more aggressive line in this issue and works based on it being possible to have government support. Risk sharing was highlighted as important between different industry segment and companies as well.

Question 4. What is the significance of gender equality to the climate transition of basic industry?

Both of the groups were in agreement that gender equality was an important issue for the actors of basic industry because it is inherently important and because it is needed for basic industry to be able to continue to attract the best expertise. The issue of how to recruit skilled employees in smaller towns was brought up in particular as it is often a problem that women to a greater extent than men are leaving the rural areas.

The groups could, however, not see any clear connection between greater gender equality and a climate transition, even if it was mentioned that a more equal organisation is probably more creative and open to changes and impressions from outside.

Question 5. What change processes in basic industry can contribute to zero emissions in the long term?

The groups discussed changes in technology and systems. More electrification was highlighted as a strong trend and an important strategy for industry's transition. Specific solutions were also discussed in various sectors, such as the steel, cement and chemicals industries, which included changes in both process technology and the raw materials side. While the technical shifts on the process side can be both overestimated and underestimated, changes in the raw material base were highlighted as a difficult challenge in several industry sectors.

One group also discussed possible changes in the relationship between companies in the value chain and the need to get a better risk spread through the whole value change. Other actors need to get involved, such as the finance industry.

Another issue that was discussed is what role Swedish industry can play and what a global distribution of new technologies may look like. Here, it was identified as an advantage that many Swedish companies are international and can thereby spread technical progress made in Sweden.

Question 6. What concrete political measures are needed in the short and the long term to support basic industry's climate transition?

There was a consensus in the groups that there is currently a need to go from the broad agreements in the Environmental Objectives Committee and the Energy Commission to more concrete objective formulations for basic industry's transformation. One group believed that one needs an industrial agreement where it clearly points out the long-term objectives. This can be common to all of industry, but also needs to be specified for each sector (steel, forest, cement, chemicals, etc.). Tied to this, concrete steps are needed along the way from demonstration to commercial facilities.

It was also pointed out that continuous dialogue is needed when going further in this issue, both between state and industry and between the political parties to maintain a broad political support in the matter.

The state's role to support the transition was discussed. It was highlighted that the state must be prepared to take some of the risks since the industry cannot do it alone. Here, an understanding was also needed that not all efforts and projects can succeed and that this is a normal part of the development work in new technologies and solutions. At the same time, it was pointed out that the state needs to remain neutral and cannot support certain industries more than others, but needs to develop support forms that are perceived as fair.

The Industrial Strides initiative was mentioned as a good first step, but a challenge is how the efforts are done there can be scaled up and how the volumes can increase. As in all risk relief, it is also important to find long-term solutions, which presuppose broad agreements.

Procurement was brought up as another important area where the state can contribute to creating markets to set requirements on higher climate benefit. Among other things, the procurement work was mentioned that is being done by the Swedish Transport Administration where climate demands are made on cement and steel, among others.

Appendix: Interview template

In autumn 2016, we held 30 semi-structured interviews. For all interviews, we worked based on the following template of interview questions, but adapted the questions to the respondent and how the interview discussion developed.

Q1. What is/was your role linked to environmental and climate issues in or related to basic industry?

Q2. How do you view the significance of basic industry to Sweden today and in the future?

Q3. How would you describe the societal governance of Swedish basic industry today in terms of environmental and climate issues?

Q4. What do you think about the pursued environment and climate policy regarding basic industry; What has worked well? What is problematic?

Q5. Who do you deem to be the most important actors in terms of impact on basic industry's environment and climate efforts? How would you describe the relationship between these actors?

Q6. How do you view the possibilities of achieving (near) zero emissions of climate gases in Swedish basic industry? What are the greatest difficulties/obstacles for achieving zero emissions in basic industry?

Q7. How should societal governance be structured to support a development towards zero emissions in basic industry? How can the state and authorities govern basic industry? What policy instruments/strategies are needed?

Q8. When we study basic industry, we note that its history is marked by male dominance in company boards, among politicians and officials who worked with the issues and in the unions and on the factory floor. Is basic industry a male dominated industry?

Q9. Which other persons do you think we should talk to in our study?