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Published in:
[Host publication title missing]

2007

Document Version:
Publisher's PDF, also known as Version of record

Policy instruments and industrial responses – experiences from Sweden

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Keywords
emission trading, regulation, voluntary agreements, energy efficiency, industry

Abstract
Industry meets different policy instruments which directly or indirectly affect energy costs and the prospects for energy efficiency improvements. There has been a general trend towards economic instruments. Specifically, emissions trading and carbon taxes has had a significant effect leading to higher electricity prices for industry. Regulation through the Swedish Environmental Code requires that energy efficiency is considered both when giving permits for industrial plants and during auditing of the compliance of activities with the general intentions of the code. The potential role of the Environmental Code as an instrument for accelerating energy efficiency has not been fully tested yet. Since 2005, the Programme for Energy Efficiency opens up for voluntary agreements between industry and government to support energy efficiency. Industry can be exempt from the minimum electricity tax in return for implementing, among other things, an energy management system. Identified energy efficiency measures with a shorter pay back time than three years should also be carried out.

In this paper we summarise the current experiences in Sweden on how industry reacts and adapts to the mix of instruments. The overall objective is to take stock of the current situation and discuss implications for future policy. The fact that energy prices have increased considerably in the 2000-2005 period is the main reason for the increasing interest in energy efficiency and associated measures. In the absence of a level playing field (e.g., global emissions trading or border adjustment taxes to compensate), we propose that regulatory and supportive policy instruments should be used much more extensively and actively than today.

Introduction
Industry accounts for about one-third of the energy used in Sweden and is a major emitter of greenhouse gases. Sweden has a long history of both environmental regulation and economic instruments and recently also introduced a system of voluntary agreements directed to energy intensive companies. The literature shows many different barriers to energy efficiency such as inadequate pricing and lack of information. Internalising the environmental costs of energy use would seem an evident solution to the first problem but it may be difficult to implement in a single country. In a small open economy as the Swedish one, the basic industry is export oriented and sensitive to changes in its comparative advantages, e.g., a history of low electricity prices and access to natural resources.

During the last five years, Swedish industry has met increasing energy prices. Oil prices increased by approximately 70% between 2000 and 2006, and electricity prices in industry almost doubled during the same period (Swedish Energy Agency, 2006a). The latter is partly due to historically high coal prices and the introduction of the European emission trading system (Swedish Energy Agency, 2005), but it is also an effect of the electricity market reform where prices are now based on marginal production costs. Adding to this, the system is increasingly interconnected with continental Europe which is expected to lead to more convergence in prices. (Trygg, 2006). The importance of the different factors are difficult to determine but it is reasonable to assume that the emission trading system has contributed to an electricity price increase on the

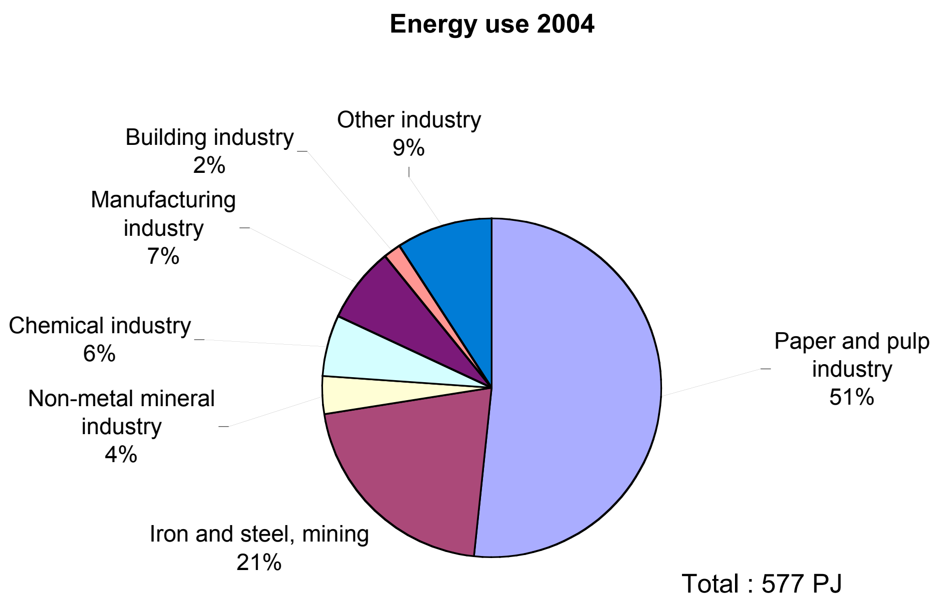

Figure 1. Industrial energy use divided among sectors.

order of about 10 Euros/MWh, or less than half of the total price increase. [1]

Price increases and changes in policy instruments have spurred a new interest for energy efficiency in industry. The aim of this paper is to provide an overview of the policy instruments in use in Sweden and analyse their experienced or potential impact on industrial energy efficiency. Based on this, directions for future industrial energy efficiency policy are suggested.

Swedish industry and its energy use

Swedish industrial energy use is dominated by the three energy intensive sectors, paper and pulp, iron and steel and chemical industry. These three sectors are together responsible for approximately 3/4 of total energy use, Figure 1. Direct carbon emissions from industry are responsible for approximately 1/3 of total Swedish carbon emissions. In industry, the iron and steel and the mineral sector (dominated by the cement sector) are the largest emitters accounting for almost half of the emissions. The paper and pulp industry, however, emits less than 10 % of industry's carbon emissions in Sweden. Compared to other European countries a relatively large fraction of energy use in industry is based on low-CO_2 energy (mostly hydro and nuclear electricity and biomass) whereas only approximately one third of the energy is fossil fuel based. This is the result of the long existing abundance of cheap electricity from hydro and nuclear and the importance of the paper and pulp industry which largely can support its energy demand with their internal by-products.

Seen from the economic point of view less energy intensive sectors are more important than the energy intensive branches. Almost 50 % of the industrial value added are for example produced in the manufacturing sector , including for example the important vehicle and electronics industries, figure 2. The energy intensity of this sector is less than 3 % of that of the paper and pulp industry. Energy and electricity intensities have been falling during the latest decades (see eg Swedish Energy Agency, 2000 and 2006) but there seem to be significant potentials still to be tapped (see eg. Möllersten et al., 2003, Thollander et al., 2005, Trygg, 2006). From a system perspective one of the main options for energy efficiency and carbon emission mitigation is to increase CHP within industry (see eg. Möllersten et al, 2003).

Barriers to energy efficiency in industry

Industry, as a professional energy user, in general pays more attention to energy costs and hence energy efficiency than actors in other sectors. However, it is a very heterogeneous sector and opportunities for, and barriers to, energy efficiency vary widely. In energy intensive industries, costs for process energy use account for a large share of total production costs, and energy efficiency has improved also during long periods of falling real energy prices. In contrast, energy use in light manufacturing may be dominated by non-process energy uses such as lighting, heating, and ventilation. The conditions are different but in all cases there are potentials for energy savings that remain untapped because necessary investments are not considered profitable, or because profitable investments are not made for various reasons. Barriers can be categorised in various ways but for the purpose of this paper we distinguish between two main types of barriers:

(1) The relatively low energy prices seen by industry compared to other users.
(2) The lack of internal motivation and capacity to improve energy efficiency in firms.

Getting the prices right is a necessary but not sufficient condition for stimulating energy efficiency investments that are economically motivated from a broader societal perspective.

1. Based on eg. Swedish Energy Agency (2005 and 2006b).

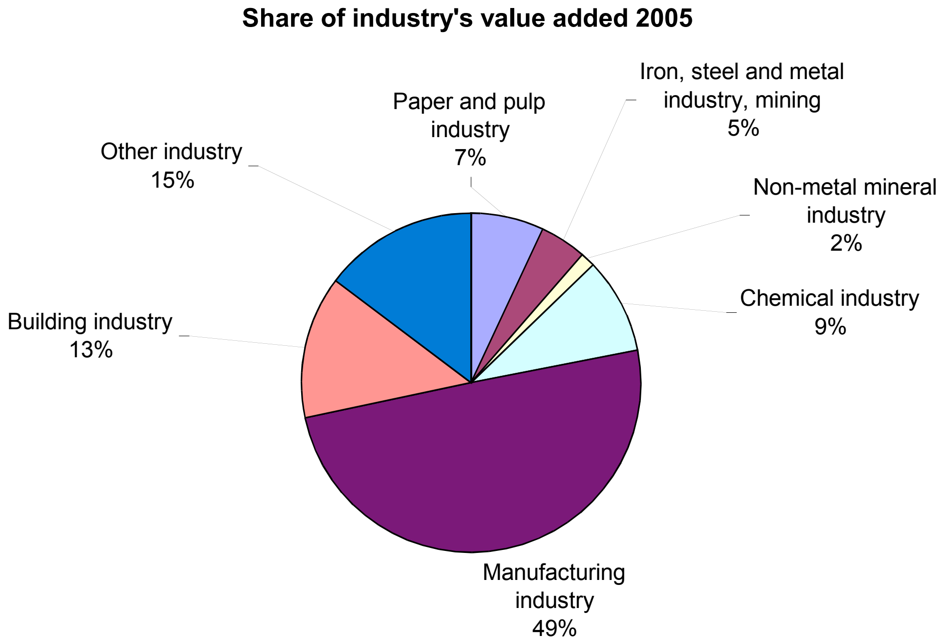

Figure 2. Industrial value added divided among sectors.

Without getting into the details of external costs from energy supply and what full internalisation would entail, industry typically pays much lower energy taxes than other users or no energy taxes at all. Furthermore, electricity intensive industries, such as aluminium smelters, have in some cases paid prices for electricity that are below production costs, and certainly below market prices. With electricity market liberalisation, such politically motivated deals are increasingly difficult to make and market prices are moving toward long-run marginal costs. It is difficult in this situation for policy makers to introduce or increase energy taxes, based on internalisation of external costs. Instead, voluntary agreements and other approaches to provide incentives for energy efficiency are tried.

The motivation and capacity to improve energy efficiency vary between firms but studies have consistently shown that firms require relatively high rates of return for energy efficiency investments (Ostertag, 2003). Lack of capital, risk aversion, transaction costs, etc., are commonly cited barriers that may explain implicit as well as explicit hurdle rates (see e.g., Rohdin et al., 2007; Rohdin and Thollander, 2006 for experiences from Sweden) The sensitivity to up-front costs has been demonstrated in studies showing that adoption subsidies are a factor of three to eight more effective than "equivalent" energy taxes suggesting that even professional industrial energy users display non-rational behaviour (Blok et al., 2004). On the other hand, non-energy benefits, e.g., improved quality or productivity, are important motivations for investments that also save energy (Worrell et al., 2003). Specific barriers include lack of knowledge and information about technical options. In addition, the monitoring and sub-metering of energy use which is needed to identify and assess energy efficiency opportunities is often lacking. Another set of barriers concern the allocation of energy costs within firms, decision making structures, split incentives due to budgetary processes, etc. Hence, a chain of conditions, including various pieces of information, as well as the incentive and ability to act on that information, is necessary for measures to be implemented, whether they require investments or changes in operational practices

Economic policy instruments

DESCRIPTION OF THE SYSTEMS

Swedish industry meets several economic policy instruments that are likely to impact energy efficiency. Industry has for a long time been subject to energy taxation which in 1991 was replaced by a carbon tax. The tax level has been stable for the last decade at a level of approximately 21 Euros /tonne CO_2 which is significantly lower than for other sectors. Furthermore there are significant carbon emissions (mainly process emissions) within industry that are not subject to carbon taxes. In addition, the most energy intensive companies have significantly lower marginal taxation as a result of important taxation deduction rules (Johansson, 2006). No carbon tax has, however, been applied on fuels used for electricity production, An electricity tax has been reintroduced for industrial consumers as a result of the EU minimum taxation legislation.[2] This tax is significantly lower than for other consumers (0.55 Euros/MWh compared to 22-29 Euros/MWh for other consumers).

Since 2005 a large fraction of industry is included in the EU emission trading system (ETS). This is yet another system that is intended to put a price on carbon emission and would lead to increasing costs for fossil fuel use. The ETS also affects companies indirectly through higher electricity prices. The EU ETS has, in combination with marginal cost pricing on the deregulated electricity market, resulted in considerable electricity price increases and has put a pressure on industry to look for

2. An electricity tax for industrial consumers was in use until 1992.

electricity efficiency improvements and other ways of reducing electricity costs.

Local investment subsidies for environmental programs were introduced in 1998. Some of these investment grants went to industry but mainly for waste heat and fuel switching projects. The focus of the programme shifted in 2002 to reducing greenhouse gas emissions and companies included in ETS are no longer eligible for support, hence significantly reducing the applicability for industry.

The green certificates system that was introduced in May 2003 is important for energy efficiency in a broader sense. Although not targeting end-use efficiency the system provides incentives for increased use of combined heat and power production (CHP) which increases overall system efficiency. The system has stimulated investments, notably biomass based CHP in the pulp and paper industry, and provided a new source of income especially as energy intensive industries are exempted from obligation to purchase any certificates. The system is designed to increase the renewable electricity production by 17 TWh until 2016.

IMPACT ON INDUSTRIAL ENERGY EFFICIENCY

Increasing the price of energy will strengthen the incentives for energy efficiency. Energy and carbon taxes as well as the ETS should have similar effects. Carbon taxes were equivalent to approximately 20 % of the price of oil for an industrial consumer in 2005 but this fraction was much higher (approximately 40 %) in the 1990s when oil prices were significantly lower. The electricity tax, on the other hand, is quite insignificant in relation to electricity prices. The introduction of an electricity tax of approximately 0.55 Euros/MWh is small compared to the 25 Euros/MWh increase in electricity prices during 2000-2006. The effect of carbon and energy taxes on industrial energy efficiency has to our knowledge not been evaluated in Sweden but it is expected that the main effect of the taxation has been more use of biomass.

The EU ETS puts a cost on CO_2 emission also from sources that were previously untaxed. During the first two years the price of CO_2 emission has fluctuated significantly. Most industrial companies have received a generous allocation of emission allowances. Both plant expansion and process emissions resulting from production increases within existing plants have been entitled to extra allocation of emission allowances in Sweden. Although a generous allocation should not reduce the incentives for emission reduction in the individual company[3], the uncertainty regarding future allocation methodologies makes it difficult for the companies to take the exact value of energy efficiency measures into account in their decision making. Should, for example, future allocation be based on more recent emission data it would clearly reduce the incentive for improvement (see e.g. Johansson, 2006). Longer trading periods and clear rules against updating are needed to reduce uncertainty and increase predictability.

Both taxes and emission trading have highlighted the longstanding conflict between efficient environmental policy instruments and the international competitiveness of companies. As only a few countries put a price on carbon and the energy intensive industry is relatively dependent on exports to countries outside Europe, the risk for plant closure or relocation has been the main reason for inefficient tax reductions and generous allocations of emission allowances to industry.

Results from a survey by Sandoff et al. (2007), sent to all companies (both energy companies and industrial companies) participating in the ETS, indicate that a majority of the responding companies[4] has implemented or intends to implement emission reducing measures as a result of the EU ETS. When looking into the future more companies intend to reduce their internal emissions rather than buy allowances on the market to manage their emission restrictions. On the question about how these emission reductions are going to be implemented the most frequent answer is through the development and implementation of new production processes. The results indicate that the EU ETS will lead to emission reduction.

A few of the local investment grants have been directed to industrial activities. Most of them have, however, been directed to fuel conversion projects. One evaluation (Forssman, 2004) focusing on the Swedish paper and pulp industry, show that the investment grants improve the profitability for making investment in energy efficient technology. However, the projects would even with the investment grants, have a too long pay back time compared to what normally seems to be reasonable (3-4 years). Looking back many of the investments that required investment grants a few years ago would today be profitable as a result of increasing oil and electricity prices.

Since the green certificates were introduced power production in industry has increased by a modest 0.5 TWh/yr. The expectation is, however, that the green certificate scheme will continue to contribute to the expansion of industrial cogeneration by another 2 TWh/yr (Swedish Energy Agency, 2007) and thus improve system energy efficiency in the future.

The economic policy instruments will generate both costs and incomes to the industrial companies, Table 1. Taxes and indirect effects on electricity prices of the EU ETS will increase industrial costs. There will however be a small potential income from surplus EU ETS allowances allocated directly to industrial companies. The electricity certificate system would lead to a significant income for, mainly, the paper and pulp industry. In total, the estimated net cost of the policy instruments 600-900 million Euros are in size about 50-70 % of the non-policy based cost increases 2000-2006. [5]

It is important to note that the effect of the policy instruments will vary significantly between the different industrial sectors. Electricity intensive companies will suffer the most, whereas companies with a major potential for cogeneration and low fossil fuel consumption will gain.

3. Early experience (Sandoff et al, 2007), however, indicates that the size of the allocation matters.

4. The reply rate of the survey was approximately 70 %.

5. The difference mainly depend on how large fraction of the electricity price increase that is attributed to the EU ETS.

Table 1. Estimated costs and incomes for Swedish industry excluding building industry as a result of current policy instruments and non policy based cost increases 2000-2006. The figures are rough estimates based on 2005 energy consumption levels.

	Costs Million Euros	Incomes Million Euros
Carbon and energy tax	280[a]	
Electricity tax	15-30 [b]	
Indirect costs of emission trading through electricity prices	450-750[c]	
Potential income from surplus emission allowances		30-60[d]
Income from electricity certificates		110[e]
Sum of estimated costs and incomes from policy instruments	**745-1060**	**140-170**
Extra costs of non-policy induced oil price increases 2000-2006	470 [f]	
Extra costs of non-policy induced electricity price increases 2000-2006	680-960[g]	
Sum – non policy based cost increases 2000-2006	**1350-1430**	

a. Data for 2003. Building industry meets the higher taxation rate and would add another 270 Million Euros to the figure.
b. The higher level is without tax exemptions whereas the lower level is including the tax exemption experienced through the voluntary agreements, see below.
c. Assuming the effect of the EU ETS on electricity prices in Sweden to range between 8 and 13 Euros/MWh.
d. Potential income if the emission allowances were sold at a price of 10-20 Euros/tonne CO_2 which was a reasonable price during 2005. Currently the price is much lower.
e. Based on production levels and certificate prices from the Swedish energy agency.
f. Based on the estimated increases in oil prices of approximately 20 Euro/MWh.
g. Based on the estimated electricity price increase of approximately 25 Euro/MWh (Swedish Energy Agency, 2006a) reduced by the estimated impact of EU ETS described in note c.

Environmental regulation

DESCRIPTION OF THE SYSTEM

The Swedish environmental code (SFS 1988:808) entered into force in 1988. The code merged the rules from 15 previous legal acts. The Swedish environmental code provides an overall legislative framework applicable to all activities that may cause damage or detriment to human health and the environment. Energy efficiency is mentioned as a key aspect already in the first paragraph of the code where it is said that the code shall be applied in such a way as to ensure that: reuse and recycling as well as conservation of materials, raw materials end energy are encouraged with a view to establishing and maintaining natural cycles.[6] In the second chapter the code states that the best possible technology shall be used in connection with professional activities. Furthermore persons who pursue an activity or take a measure shall conserve raw materials and energy. Both this rules of consideration shall be applicable where compliance cannot be deemed unreasonable. Particular importance shall be attached to the relation between benefits and costs. [7]

The rules of the environmental code can be implemented through two different processes. One is through issuing permits and one is through supervision. In principle, all industries must have a permit for their activity. The permit is conditional with possible requirements regarding production levels, emissions to air and water etc. In connection with the implementation of the European emission trading system no condition regarding CO_2 emission is applicable to activities included in the trading system. It is, however, possible to define conditions regarding energy efficiency but this rule has rarely been tested in court.

The purpose of supervision is to ensure compliance with the objectives of the code and rules issued in pursuance thereof.[8] The supervisory authority may require information from the plant owner that is necessary to evaluate whether the conditions of a permit are followed or if the activity is generally consistent with the objectives of the code.[9] The authority can also, when it finds it necessary, require that the company suggests improvement measures (Swedish EPA, 2001). During recent years there is a growing interest among the supervisory authorities to involve energy efficiency in their work, see below.

ENERGY EFFICIENCY IN THE PERMITTING PROCEDURE

The possibility to include energy efficiency requirements in the environmental permits has recently been tested in environmental court regarding a pulp industry in western Sweden. The Swedish Environmental Protection Agency (Swedish EPA, 2005) argued that the company should pursue more energy efficiency measures than was intended by the company. Much of the discussion dealt with the issue which measures could be required of the company without being unreasonable. The agency argued that the decision should be based on i) a cost benefit analysis based on a social interest rate (4 %) rather than the company's interest rate of 15% and would ii) include monetary values for environmental impact. The environmental court agreed that an interest rate no higher than 6 % should be used. The court also argued that it is not reasonable to require the same returns for measures called for according to the environmental code as for other investments in the company. Regarding the individual measures discussed no final decision was taken and the company achieved a permit to continue its plans while the specific requirements were passing a probation procedure which can take years.

In the above mentioned case the measures were evaluated one by one. In another case, however, the Swedish EPA(2006) tries to introduce specific requirements of specific energy use for a paper company. The process has, however, not gone so far as to the environmental court yet.

To summarise, although there seems to be room for energy efficiency requirements in the probation procedure, the pro-

6. The environmental code chapter 1, paragraph 1.
7. The environmental code, chapter 2.
8. The environmental code, chapter 26.
9. The environmental code, chapter 26, paragraph 21.

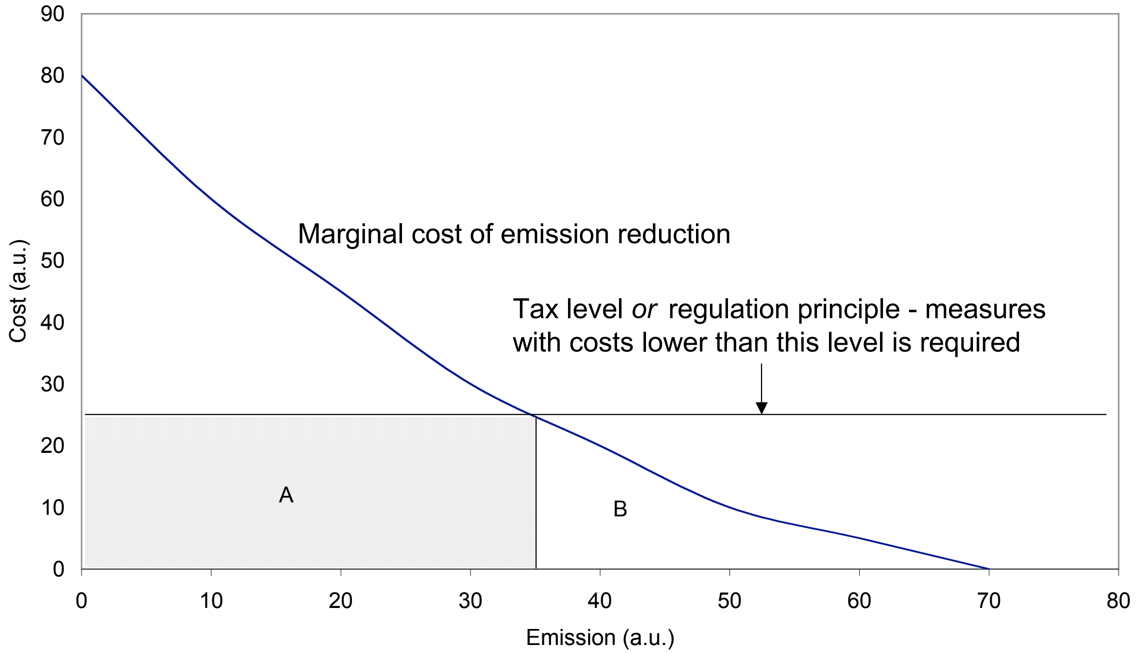

Figure 3. Principal illustration on how an emission tax or a regulated emission reduction will affect a company's economy. In both cases, the company will pursue measures with a total cost equal to the area B. In the tax case, the company will in addition have a tax cost for unabated emissions equivalent to area A. Adapted from Johansson (2006).

cedure seem to be rather slow. It seems, however, that legal grounds exist to pursue measures that would not have been done according to internal company investment rules. The use of 6 % real interest rate instead of 15 % and a longer pay back period than the 3 years often used within industry would be more important than even large increases in CO_2 taxes. [10]

There are only few cases in which the regulation has been tested and it is difficult to evaluate the efficiency of the permitting procedure as an instrument for improving energy efficiency. From the company perspective, requirement for energy efficiency through the probation procedure could have an advantage compared to economic instruments as it will only include costs directly related to investments, Figure 3.

ENERGY EFFICIENCY AS A FACTOR WITHIN THE SUPERVISION PROCEDURE

The supervision procedure is intended to see that the conditions of the permit are withheld *and* that the general rules of consideration, stated in the law, are held. In order to provide security to the company, the supervision authority cannot require measures above the conditions stated in the permit. But as energy conservation very seldom has been discussed during the permitting procedure, it should be able to deal with during supervision on the basis of the general rules of consideration. Several regional authorities in Sweden have started working with energy issues within their supervising work. For example, the regional authority of Dalarna has started a supervision project intending to improve the companies' knowledge of their opportunity to improve energy efficiency. The project includes information seminars, inquiries to identify the need for supervision visits and to get information of planned projects etc, energy education for the supervising personal and supervising visits at the companies. Finally the companies have to make a plan which includes information on which measures are planned to be carried through, when this is going to happen and who is responsible. The experiences of the supervising visits indicate increased interest in energy efficiency (Bergman, 2006). It is still too early to make any final conclusions of the efficiency of the supervision. The energy auditing process initiated through the supervision work might however reduce the lack of information within companies and increase the probability for measures to be carried through.

Voluntary agreements

DESCRIPTION OF THE SYSTEM

In response to the EU Directive on minimum tax rate of approximately Euro 0.5 per MWh electricity, the Swedish government introduced a bill which came into force on January 1, 2005 and gives energy-intensive companies the opportunity to obtain tax exemption. The programme is aimed at the manufacturing industries (with the exceptions of metallurgy, electrolysis and chemical reduction) and let them voluntarily participate. In exchange for the tax exemptions, the companies are required to introduce an energy management system and to actively take actions to reduce their electricity consumption. The programme is known as PFE (Swedish acronym for Programme for Energy Efficiency) and will run for five years. During the first two years participating companies will monitor their energy use and generate a list of measures to improve electricity efficiency. These companies must also introduce a standardised energy management system which must be certified by an accredited certification body. By using an energy management system the idea is to improve operating and main-

10. For example, an investment in oil conservation, viable with an interest rate of 6 % and 10 years payback time at current oil prices, would require a carbon tax of Euro 80/tonne CO_2 if an interest rate of 6 % and 10 years payback time was used instead. This is approximately 10 times the current Swedish level.

tenance procedures, to do more conscious planning, to use better purchasing procedures etc in order to reduce the energy consumption.

The Swedish standard for energy management system (EMS) has been designed to complement the international environmental management standard ISO 14001 which makes it possible for a company to co-ordinate or integrate EMS with its existing management system. This has made it fairly easy for all companies with an already certified management system to complement it with the new EMS.

Among the procedures stated in the PFE programme is one which obliges the company to purchase the highest energy-efficient class of electrical equipment if the pay-back period is less than three years compared to a "conventional" alternative. It is up to the companies to be able to show the various alternatives being considered during the project work. From the quotations achieved it will be possible to rank the alternatives from an electric efficiency point of view and then make the necessary calculations for determining if the best energy alternative also is economically viable according to the rule of maximum three years pay-back time.

After five years the company will report the effects of the PFE programme. If the company has been able to reduce the energy consumption as much as would have been achieved if the tax had been imposed, then the company is considered to have fulfilled its obligations. It is of course not possible to easily judge if a company has achieved the equivalent goal for energy reduction as there are so many factors influencing what can be done in a fairly short period of time. Therefore a "broadly speaking" concept will be applied which means that the Swedish Energy Agency will not only look at each individual company's effort but also consider the total effect of all participating companies.

As there are no strict criteria set it is finally up to the Swedish Energy Agency to decide whether an individual company has done a satisfactory effort to reduce the electricity consumption. If so the tax exemptions are then formally approved by the Swedish Tax Agency.

EARLY EXPERIENCES AND EXPECTATIONS

The vast majority of the companies classified as energy-intensive and eligible to participate have entered into this voluntary PFE programme. Around 130 companies with a total of more than 270 production units are active at present representing 85 % of the total electricity consumed in this group. This means an annual electricity use of approximately 30 TWh and the tax exemption granted is in the order of Euro 16 million/year.

There are some important factors behind the enthusiasm for participating in the PFE programme. One factor is of course the tax relief which in most cases more than compensates for extra costs in introducing energy management system and certification of it. Another very important reason for the energy-intensive companies is the sharp rise in energy prices during the last couple of years. It is not unusual that the energy bill is two to three times higher than a few years ago. This has triggered many activities to trim the energy costs and the management team in these companies often looks upon energy management system and PFE as a valuable tool to curb the escalating cost trend.

How much energy can possibly be saved during the five-year programme? There are to date very few estimates but it is not uncommon that the individual companies set a goal in the order of 1 % per year calculated as specific reduction (electricity per unit of production) and even higher for fossil fuels. To start with, some simple corrections have already been done like finding all compressed air leakages and switching off lighting not necessary for a safe production. Another factor which will contribute to a reduction is the, in comparison with existing plants, higher technical standard for all process plants being commissioned or revamped during the five-year period. Previous fairly low energy cost could not justify the highest standard of the equipment but the situation has now changed very much in this respect. Many companies have already stated that only electric motors with the highest efficiency class will be used irrespective of the pay-back time for alternatives.

Recently the first indication of what possibly can be obtained was published by the Swedish Energy Agency. The total reduction indicated from the participating companies at the end of the five-year period is in the order of 1 TWh/year which is 3-4 % of the total electricity used today by these companies. The investment for these activities is estimated to be in the order of Euro 100 million.

The bureaucracy has been kept to a minimum and the participating companies can handle all documents with electronic signature via the Internet to the Swedish Energy Agency. So far companies involved in the PFE programme seem to be satisfied with the first two start-up years. It remains to be seen what the total effect will be when the programme will be evaluated in 2010.

Discussion and conclusions

Energy efficiency policy instruments targeting or indirectly affecting the industrial sector in Sweden can be divided into three categories:

- Economic instruments such as carbon dioxide taxes and ETS
- Regulatory instruments, i.e., the Environmental Code which potentially can be used to mandate energy efficiency improvement
- Supportive instruments, i.e., the voluntary agreement called Programme for Energy Efficiency

The overall burden placed on industry so far through energy policy instruments is lower than the cost increases driven by higher prices for fossil fuels and electricity. We conclude that the revived interest in energy efficiency in Sweden can be almost exclusively attributed to energy price increases. These have placed energy issues firmly at the top of the agenda of high level management in industry. The launch of the Programme for Energy Efficiency in 2005 was in this context very timely and it has provided tools for, as well as legitimacy to, a stronger pursuit of energy efficiency opportunities in Swedish industries.

For economic instruments there is a history of special reductions and exemptions from energy and environmental taxes. ETS in Sweden and elsewhere has been based on free and generous allocations of emission permits. The explanation, of course, is fear of loosing industrial competitiveness. The result is that other sectors must carry a relatively greater burden and that relatively more cost-effective investments in industry are foregone. The political challenge, and the challenge for policy makers, is to design instruments that provide economic incentives for improvements but simultaneously avoid detrimental effects on industrial competitiveness. This issue has fuelled the discussion on instruments that target marginal energy use or emissions but do not result in an overall economic burden for industry. Examples include intensity based allocations of emission permits, taxes on marginal energy use, and changes in the electricity price mechanism into a two-tier system with part of the consumption priced lower than the marginal cost in the system. All these approaches suffer from drawbacks in terms of how they can be designed, and updated. In addition, they do not result in the product price increases that would be desirable in order to moderate demand for basic materials through appropriate market price signals.

Reverting to "command and control" through requiring energy efficiency in the permitting and supervision of plants as facilitated by the Environmental Code, may offer a way out, albeit a complicated one. Regulation may have a penalty in that it does not ensure efficient economic allocation within the industrial sector but it has a benefit in that it need not create an excessive economic burden for industry. In general, when trading off energy costs for capital costs in energy efficiency investments there is a broad minima in the life-cycle cost function, i.e., there is typically a small penalty for "over-investing" in energy efficiency, and vice-versa (Steinmeyer, 1998). A major drawback is the regulator's dependency on the regulated party due to asymmetry of information and the risk of loosing technological and market dynamism. The use of regulation is also enveloped in a judicial system which typically results in lengthy procedures and appeals to higher courts.

Supportive instruments such as voluntary agreements, free audits, investment grants for demonstration projects, information, etc., are largely unproblematic from the perspective of competitiveness, unless they are perverted into excessive subsidies or are designed so that the market for energy services is ruined. Experience shows that various voluntary agreement schemes and energy audits can have a measurable impact on energy efficiency (Ericsson, 2006; Khan, 2006; Modig, 2006). Energy auditing required through the environmental legislation could be seen as a middle course between strict energy efficiency regulation and the voluntary approaches.

In our assessment there is no escaping from the need to put a much greater burden on industry to improve energy efficiency and contribute to reductions in greenhouse gas emissions through process changes, higher product prices, and structural change. However, a global emissions trading system as wished for by many is not even on the horizon and there is no guarantee that such a system, assuming free allocation of permits, would provide the level playing field that everyone agrees should be there. The alternative option, i.e., to introduce border adjustment taxes, may be visible on the horizon (EC-HLG, 2006)) but it may also stay there due to the potentially dire consequences for free trade agreements and unintended protectionism. In the likely outcome over the next 10-20 years that international competitiveness will remain a barrier to economic instruments in industry, we propose that regulatory and supportive policy instruments should be used much more extensively and actively than today.

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