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THEORETICAL FOUNDATIONS AND EU REGULATION OF CARBON-DIOXIDE EMISSION TRADING

This study forms part of the research project entitled 'Directive introducing the carbon-dioxide trading scheme of the EU, tasks relating to adoption and the expected budgetary impacts'.

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Summary

Following the adoption by Hungary of the EU directive on CO_2 emission trading, the emission of carbon dioxide will become a new factor of production for the companies concerned. Like capital, labour, land or other natural resources, CO_2 emission permits will become a scarce resource. Scarcity is a source of value, i.e. the right to emit carbon will be the right of a property and a business value, the ownership of which results in rent being earned.

At present, the rights of emission are held by the state. If the state transfers all the emission permits free of charge to the companies concerned, the whole of the scarcity rent will turn into a windfall profit for such enterprises. If, however, the state sold part of the emission allowances, some of the profits stemming from scarcity would be retained by the state. The state may withhold all or part of the scarcity rent. If only part of the rent is withheld, it will be easier to involve industry in the development of the relevant regulation. This may be achieved by handing some of the emission allowances to companies free of charge and auctioning the rest.

The state should earn revenue from the sale of the scarce allowances. On the one hand, this is in line with the generally accepted environment regulation principle (which is also recommended, for instance, by the EU and the OECD), i.e. the Polluter Pays Principle; on the other hand, the government will face a variety of additional tasks as a result of climate change (prevention and alleviation of damage, e.g. droughts, floods, etc.) for which additional revenue must be raised. Instead of through general taxation, such revenue may be raised by auctioning the allowances.

The state could also reduce tax rates using revenues acquired from auctioning the allowances. In this case, the distortion of the economy by the existing tax system could be alleviated by cutting taxes levied on operations that are considered to be socially or politically desirable. Depending on the taxes whose rates are lowered using such allowance revenue, this measure would benefit various industries or economic sectors. Accordingly, reinvesting such revenue would, to some extent, also reduce the costs faced by enterprises in complying with the regulations.

The lobby activities aimed at the representation of the interests of various industries are based on the protection of the positions of those operating in the industries concerned, i.e. the 'incumbents'. The state needs to address this issue from the viewpoint of efficiency, since the way the initial distribution of the emission allowances is made, when they turn from being public goods into being privately owned, needs to be aimed at achieving efficiency. Well-founded economic arguments call for at least part of the allowances to be allocated to companies at auction.

Introduction

Hungary, as a member of the EU, is obliged to introduce trading in emission permits and to decide on the distribution of their ownership. This study provides an overview of the theoretical background to this decision and the relevant EU regulations.[1] Part one discusses the economic interpretation of the emission allowances and reviews the economic impact of the different modes of regulation. The second part of the study describes the current EU regulation, evaluating its economic impact.

Theoretical foundations of emission trading, economic considerations

Under an approach based on economic foundations, just as in most other government programmes, so economically efficient goals must be identified in the field of climate protection. The means of regulation that best ensure cost-effective implementation of these goals have then to be identified. This requires an assessment to be made of the social benefits and costs of the expected regulatory effects, both desirable and unintentional.

When it came to climate change, the emission targets were not selected on the basis of an optimum economic solution. (For more details see Nordhaus and Boyer, 1999, 2000.) Economists did play a role, though, in implementing the established targets, and they have designed a number of regulatory instruments to improve the cost-effectiveness of the way the climate protection targets are met. A number of traditional tools, together with modifications of these, have been used, and a variety of entirely new tools have been created. The economic aspects of tradable emission rights (allowances) – the instrument that is expected to play the largest single role – are discussed in this study.

This section begins with a brief summary of the theoretical foundations of emission trading, which is also viewed by the EU directive as an economic type of environmental regulatory instrument. This is followed by a summary of the economic considerations we regard as most important in relation to the development of regulation in Hungary.

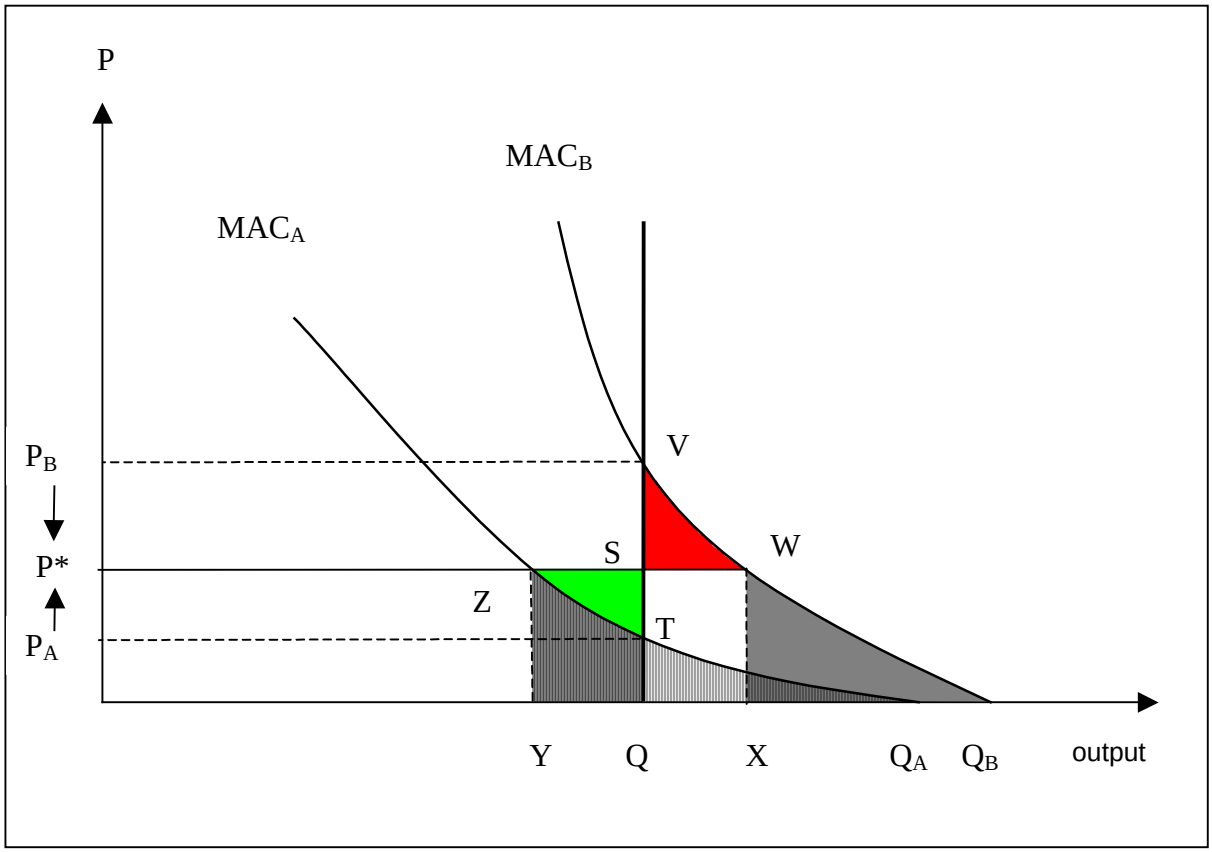
[1] In a future study the energy market will be used as an example for the description of the economic impact that may result from the distribution of ownership rights based on different principles.

The system of tradable emission allowances as an economic regulatory instrument

Having decided on the quantity of the pollutant whose emission they intend to limit, the authorities may offer economic entities the entire permissible quantity of emissions in the form of unit allowances or permits, on the understanding that, in future, only organisations that have such allowances may emit quantities of the pollutant concerned. If the allowances are transferable, an equilibrium market price will evolve, which means that the emission of a unit will cost the same for all polluters. The market price of an allowance reveals the opportunity cost of pollution for the polluter: this is the amount it could earn by selling its unused allowance. If, however, emission abatement technology is found at a cost below this market price, that technology will be introduced by companies, which operate in competitive markets, in order to maximise their profits (Montgomery, 1972).

The following figure clearly indicates the difference between individual emission limit values and tradable emission allowances. Let us assume that the authority intends to permit pollution of volume *2Q* in a market comprising two polluters.

Figure 1. Cost-effective emission reduction with tradable emission allowances in the case of two companies with different abatement cost curves



Since two manufacturers will almost never have identical marginal pollution abatement cost curves (MAC_A ; MAC_B), if both companies had separately to comply with emission level Q, as is the case with individual emission permits, Company A would reduce its emission by an amount of $Q_A - Q$ at a cost of QTQ_A. Keeping within the same emission level Q would be much more expensive for Company B: it could reduce its emission from level Q_B to level Q only at a total cost of QVQ_B.

If, however, the authority permits free allocation of the total emission of $2Q$, the result will be completely different. Since the marginal abatement cost curve of Company A is much more favourable than that of Company B, it is better for both companies if B pays A to cut its pollution further and to transfer part of its emission allowance to B. The exact price of such an agreement, and the distribution of pollution, will depend on numerous factors, but it can be approximated on the basis of the above curve. The last unit of the abatement of emissions from Q_B to Q would be a very high – P_B – marginal cost, while Company A could reduce its emissions by an additional unit at the much lower marginal cost of P_A. The difference between the two marginal costs would be somewhat smaller, but still quite substantial, in the case of the next to last unit of abatement of emissions. This difference will support the sale and purchase of emission allowances until the difference between the marginal costs disappears. At this stage Company B would be at point X, and Company A would be at point Y. It would then be cheaper for Company B to prevent the next unit of pollution than to pay Company A, and therefore the $Q_B - X$ quantity would be prevented by Company B. Accordingly, the market price of the allowances will settle at P^*, which equals the equilibrium marginal costs.

What is the total benefit gain? If the equilibrium price of the allowances is P^*, the total revenue of Company A from the transaction would be $YZSQ$. The total cost of preventing the extra emissions is reflected by the area under its own MAC curve, the size of which is $YZTQ$, i.e. it would have demanded at least this amount for the transaction. However, since it has charged a price of P^* for the sale of the emission allowances, Company A earns a profit on the transaction of ZST.[2] Company B would have been willing to pay a much larger amount – a total of $QVWX$ – to avoid having to reduce its emissions to the level of Q, instead of only to level X. Accordingly, the total benefit equals $QVWX - YZTQ$.

As described above, substantial cost reductions can be achieved, and even a net social benefit attained, if allocation of emissions allowances is permitted on the basis of market mechanisms. This assumes that the nature of the emissions is such that the authority need not set a separate individual limit for each polluter. CO_2 is typically, indeed ideally, such a material: it has no local effects at all that would make the growth of CO_2 emissions harmful at certain locations. Only the globally emitted quantity is important, and even then, of the total quantity, it is only the stocks that accumulate in the atmosphere on a permanent basis that make a difference.

[2] The figure will be modified in the case of transaction costs.

The system of tradable allowances ensures that pollution does not exceed the limit set by the authorities. Accordingly, this system is highly reliable in meeting environmental goals, though the costs entailed are obviously uncertain, since the price of the allowances is determined by the market. As a consequence, the actual price of the allowances (and the opportunity cost of retaining an allowance) may vary quite substantially. If there is a need for regulation based on a predictable cost level price, then emission taxes are probably more suitable.

The most sensitive practical problem relating to regulation by tradable allowances is associated with the distribution of emission permits, i.e. the initial allowance allocation. If the trade in allowances does not carry a transactional cost, the initial allowance allocation will not influence the efficiency of regulation: companies competing with one another and aiming to maximise their profits will also try to reduce the opportunity cost by using the market, i.e. there is a willingness both to sell and to buy, and consequently optimum pollution allocation may be expected to develop quickly. At this point, the initial allocation of the allowances has an influence on income transfers. Rent-seeking definitely needs to be taken into account. And if it is (rightly) assumed that substantial transaction costs hinder the trading in allowances, or if a dominance develops in the market of allowances or of products – which may even reinforce one another – the initial allowance allocation may also have a substantial effect on the efficiency of regulation, for such factors may hinder the balancing of the marginal cost of emission abatement. The issues of allocation will be dealt with in more detail in the related study No. 2.[3]

Economic questions relating to the development of regulation

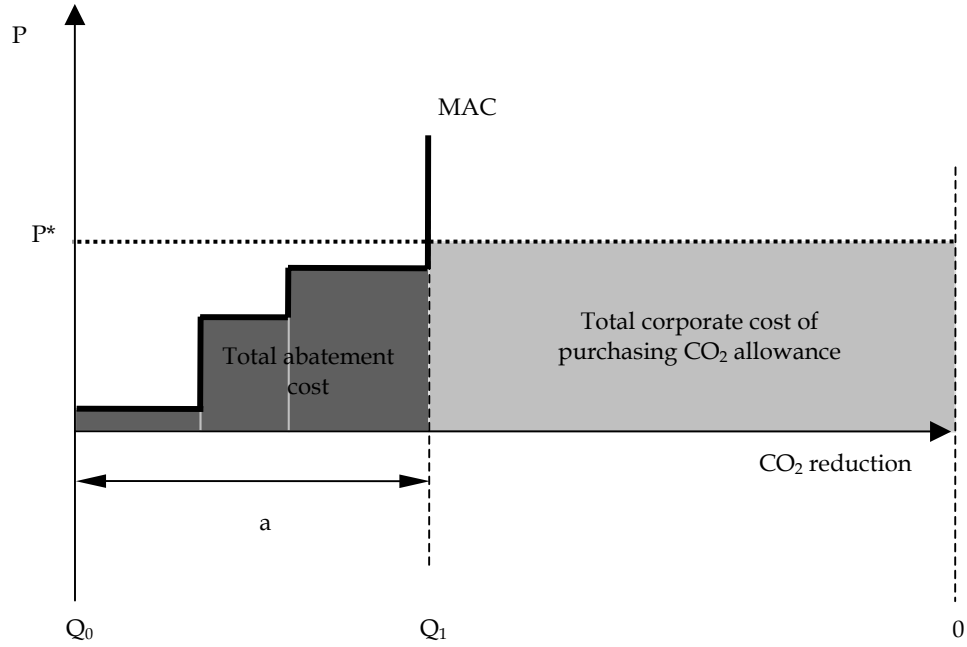
Effects on rents

As a result of the regulation, the emission of CO_2 into the atmosphere will become a new factor of production for the companies concerned. Just like capital, labour, land or other natural resources, CO_2 emission permits will become a scarce commodity. Scarcity is a source of value, i.e. the right to emit carbon will be a business asset, the ownership of which results in rent being earned.

At present the rights of emission are held by the state. If the state sells the rights to emit CO_2 to companies, the rent associated with scarcity will be collected by the state. This may be achieved, for example, by auctioning the whole of the available allowances. The effects on CO_2 emissions and reallocation are illustrated in the following figure.

[3] In the process of publication, 12th Working Papers of the Ministry of Finance.

Figure 2. Development of CO_2 emissions and the distribution of rent in the case of the auctioning of all the allowances



Abbreviations used in the figure:

P: price, cost, benefit (e.g. HUF ,000)
Q: emission abatement, quantity of CO_2 emission reduction (e.g. in tonnes/ year)
a: total abatement, the quantity of CO_2 emission prevented (e.g. tonnes/year)
MAC: CO_2 marginal abatement cost curve (e.g. HUF ,000/tonne)
*P**: equilibrium market price of CO_2 emission allowance (e.g. HUF ,000/tonne of emission allowance)
Q_0: original CO_2 emission
Q_1: CO_2 emission after the reduction in emission

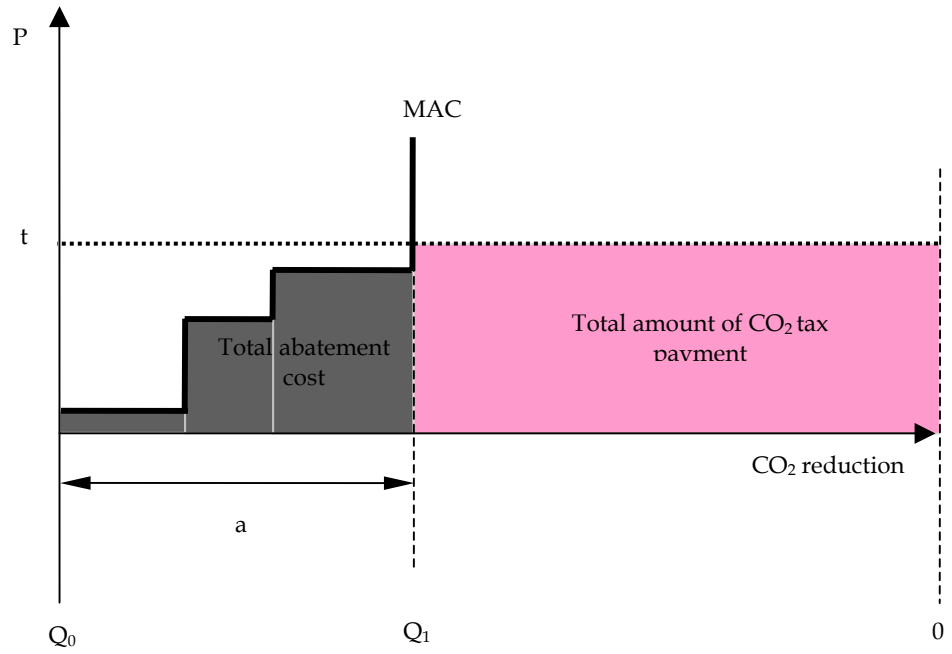
It is clear that companies will prevent the emission of a quantity *a* of pollutant by all means, because its total cost is lower than purchasing an allowance that corresponds to quantity *a*. For the rest of the emissions they will purchase allowances, since their marginal emission abatement cost exceeds the marginal cost of purchasing allowances. On the whole, therefore, they will purchase allowances for an amount of $Q_1 \times P^*$ from the state and the rent on the scarcity of this 'resource' will be collected by the state.[4]

[4] In fact, the amount of the rent to be received by the state will depend on the valuation of the scarce CO_2 emission allowances by the market at the time. If scarcity prevails in the longer term and, despite technological advances, the economy continues to emit CO_2, the scarcity value may even increase – something that may not have been foreseen by the markets. Accordingly, as a result of economic growth and of the increase in demand for CO_2 emission permits, further substantial amounts of rent may be collected by entities that today purchase scarce emission permits at auction. By contrast, if

It is more appropriate to refer to the retention of rents in community than in state ownership, for, rather than exclusive ownership by the state, what we have is the possibility of CO_2 and other greenhouse gas (GHG) emissions from a wide variety of other production and consumption activities, too. For all operations, whether or not they participate in the trading scheme, have to share in the limited total national emission allowance. The state could levy a CO_2 tax on trading and non-trading activities alike, which could keep emissions below a given level, if the Hungarian state were to strictly enforce the total GHG ceiling – which would, indeed, be expected of the state as a member of the European Union (for more details see section 3).

The following figure shows that, from the aspect of rent, the levying of a CO_2 tax is a solution equivalent to auctioning, if the rate of the CO_2 emission tax equals the equilibrium price of the allowances that would otherwise be auctioned.

Figure 3. Development of CO_2 emission and rent distribution in the case of the introduction of a CO_2 tax



Abbreviations used in the figure:

P: price, cost, benefit (e.g. HUF ,000)
Q: emission abatement, quantity of CO_2 emission reduction (e.g. in tonnes/ year)
a: total abatement, the quantity of CO_2 whose emission is prevented (e.g. tonnes/year)
MAC: CO_2 marginal abatement cost curve (e.g. HUF ,000/tonne)

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economic development is not as CO_2 intensive as expected, the existing markets may overestimate the value of acquiring scarce emission permits.

t: rate of the CO_2 tax (e.g. HUF ,000/tonne of emission)
Q_0: original CO_2 emission
Q_1: CO_2 emission after the reduction in emissions

The above figure shows that levying a tax of rate *t* would result in a reduction in emissions of quantity *a* in the business sector. The amount of tax revenue accruing to the state would be:

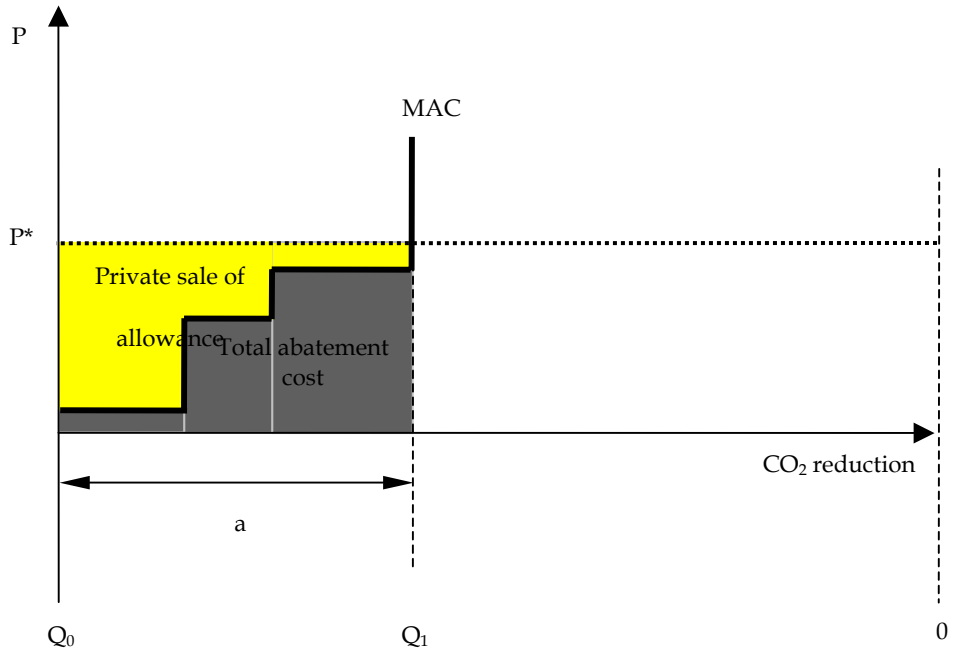
$$Q_1 \times t$$

If *t* equals the equilibrium allowance price – *P** – in the alternative case of auctioned allowances, the CO_2 tax revenue to the state equals the revenue from the auctioning of allowances.

The state may withhold all or part of the scarcity rent. If only part of the rent is withheld it will be easier to involve industry in the development of the relevant regulation (Baumol and Oates, 1988). This may be achieved by giving away some of the allowances free of charge to the enterprises concerned, auctioning the rest, or making it possible for companies to acquire allowances for fixed-price payments, similar to a tax. Though not so efficient, this latter solution does avoid the price risk of an auction, and at the same time it imposes a ceiling on the secondary market price of the allowances (McKibbin and Wilcoxen, 1997; Pizer, 1997).

If, however, the state transfers all the emission permits to the enterprises concerned free of charge, the whole of the rent associated with the scarcity of this commodity will turn into an extraordinary profit for the recipient enterprises. The effects of this extreme solution on CO_2 emission and on the redistribution of the scarcity rent are shown in figure 4.

Figure 4. Development of CO_2 emission and rent distribution in the case of the allocation of CO_2 emission allowances entirely free of charge



Abbreviations used in the figure:

P: price, cost, benefit (e.g. HUF ,000)
Q: emission abatement, quantity of CO_2 emission reduction (e.g. in tonnes/ year)
a: total abatement, the quantity of CO_2 whose emission is prevented (e.g. tonnes/year)
MAC: CO_2 marginal abatement cost curve (e.g. HUF ,000/tonne)
*P**: equilibrium market price of CO_2 emission allowance (e.g. HUF ,000/tonne of emission allowance)
Q_0: original CO_2 emission
Q_1: CO_2 emission after the reduction in emissions

Two important points should be highlighted with respect to this figure. Let us assume that the equilibrium allowance price has not been altered by the distribution of allowances free of charge instead of at auction. (This situation may be possible, for instance, in relation to a large, uniform, liquid trading system and a small partial market.) In this case an observation needs to be made, which may perhaps be surprising at first sight, i.e. that the total abatement *a* equals the amount of emission abatement in the case of distribution at auction. Accordingly, instead of through the distribution of allowances, the trend in CO_2 emissions is determined by the development of the costs of emission and the costs of reducing emissions. (For further details see Montgomery, 1972).

It should be noted that the low marginal cost of reducing emissions means that companies will sell part of the emission allowance (Q_0) they have been allocated. The revenue from the sale of the allowances – ($Q_0 - Q_1$) x P^* – will be booked by the seller companies, from which they will derive an extraordinary profit after the costs of emission reduction are deducted. This profit is a windfall profit, originating exclusively from the introduction of the regulation.

The efficiency of regulation

Exclusively quantity-based regulation in an allowance trading scheme would entail excessive uncertainty as to the social costs of compliance. It is theoretically proven that it is extremely difficult to achieve a regulation scheme that is efficient enough from the perspective of meeting the goals of climate protection, exclusively through quantity-oriented objectives (allowances) (Weitzman, 1974; Nordhaus and Boyer, 2000). Furthermore, quantity-oriented regulation is also vulnerable from the aspect of redistribution as well. At the same time, quantitative regulation does have the political advantage of ensuring compliance with the quantity limits without revealing the costs (Kerekes, 2001). In the case of certain environmental problems, the establishment of such a limit is justified (e.g. regulation of the emission of extremely toxic substances), but in the case of greenhouse gases there is no argument for a quantitative goal that must be attained at any cost. The possibility of a purely price-based regulation is ruled out by Hungary's integration policy. As far as Hungary is concerned, it is especially important to emphasise that price-based regulation – e.g. through taxation – has a very valuable feature, namely that it is possible to clearly identify the cost of compliance with the regulation. The most important argument against it is that the quantity of CO_2 emission becomes uncertain. Protection against this is offered by hybrid or open-ended systems.

Open-ended quantity-based regulation may be the best solution for Hungary, even if, alongside the primary GHG polluters, the electricity generating market is taken into consideration. Hybrid systems combine free allowance allocation with some allocation mechanism that contains an economic efficiency incentive, such as auction-based or fixed-tax-based allocation. A hybrid regulation system would mean the allocation of a limited quantity of allowances free of charge, followed by the development of a secondary market for allowances, where additional emission allowances may be purchased to top up the allowances received free of charge. A hybrid system combines the flexibility of the allowance system with the transparency of the taxation system. This could also provide protection against the adverse market impacts of oligopoly structures in the power-generating market and technological factors.

Accordingly, the planning of an efficient national GHG regulation requires the distribution of a quantity of emission allowances free of charge that is below the original emission level but that exceeds zero (Pezzey, 2003). This level should probably be determined on the basis of political, rather than economic, efficiency. In

one of our papers relating to this issue (Lesi and Pál, 2003) there is a proposal for a method to determine the economically desirable amount of free allowances without excessive windfall profits or stranded costs for the regulated companies. This level may be referred to as a rent-neutral allocation *because in principle there may be a quantity where the net rent effect of the windfall gains and losses from the allocation of free allowances and the introduction of the CO_2 regulation equals zero.*

The regulatory preliminaries of the EU CO_2 emission trading scheme

EU climate protection policy is developing in a political atmosphere dominated by the much-debated Kyoto Protocol and the diplomatic processes surrounding its ratification. Nevertheless, on a political level, the EU (i.e. the Council and Parliament) has also approved the Commission's initiative that, regardless of the success of the Kyoto Protocol (its coming into force and the fulfilment of the commitments), the EU should incorporate implementation of the GHG emission reduction objectives of the member states in the community body of law (COM[2001]579). The following section presents an overview of the regulatory preliminaries to this decision.

The Kyoto Protocol

The third conference of participants in the UN Framework Convention on Climate Change, which saw the Kyoto Protocol adopted, took place in December 1997 after decades of technical and professional debate and over five years of international diplomatic preparation (UNFCCC [1997]). In its original version, the countries listed in Appendix B to the Protocol undertook to make a reduction in the emission of greenhouse gases (GHG) specified by the Protocol to below the 1990 level, by a percentage averaged over the five years between 2008 and 2012. Overall, the nations undertook to reduce emissions by 5.2%. The Protocol will come into effect once at least 55 countries have ratified, provided they represent at least 55% of the total GHG emissions of the countries that have made their commitments. The debates in the years following the adoption of the Protocol have shown that this is going to be a very tough condition indeed. Without the participation of the US, it is very difficult to see the Protocol entering into effect. For this reason – and in view of the increasingly resolute intent of the US to stay out of the Protocol – the governments of the countries committed to the Protocol, UN diplomats and various green movements have started to modify the framework in an effort to persuade some hesitant states to join. In March 2001, when the US officially announced that it would not ratify the Protocol, it was already clear that the original concepts would have to be modified in respect of two major issues that emerged during the rounds of negotiations in Bonn and Marrakech. One is the issue of compliance by means of domestic measures, and the other is the question of so-called 'sinks'. Sinks are areas where carbon dioxide, removed from the atmosphere by vegetation, primarily by

trees, is fixed in the long term. Later on (in Bonn and Marrakech) existing forests that, if preserved, have large GHG storage capacities, were also recognised as sinks. In parallel, the EU also gave up its previous, firmer standpoint concerning the rather limited role of international carbon trade and accepted that the participants may conduct substantial carbon trading as well as relevant domestic actions. This was a major concession on the part of the EU over what is referred to as 'hot air'. For the debate was not centred on what had already been proved by numerous economic models, that international carbon trading – if certain conditions are met – can substantially reduce the cost of fulfilling the commitments (see, for instance, *The Energy Journal* Special Edition 1999). What caused the insistence on domestic action contrary to the above was, firstly, the GHG quantity of 'hot air', the emission of which was cut by the former socialist countries 'incidentally', as a consequence of the decline in domestic output in the crisis following the collapse of the centrally planned economy, and secondly the fact that the slow economic growth that had begun stemmed from a less energy-intensive structure. This immense quantity would offer one of the cheapest abatement options in the international trading system for the developed countries as well. According to some research findings (Böhringer, 2002) if no restriction is placed on the sale of the already reduced quantity (hot air) existing in the former socialist countries, then, with the abstention of the US, the effects of the Kyoto Protocol will practically vanish and carbon prices will be reduced to zero. The reason for this is that the GHG volume undertaken to be reduced by the developed countries – minus the USA – is more or less equal to the quantity of hot air readily available for sale in Russia, the Ukraine and the rest of the East European countries. This situation could only be changed to some extent if Russia acted as a monopoly seller, making efforts to raise the price of emission permits above zero through some quantitative restrictions. This could actually lead to some additional emission reduction. This issue will be largely determined by the development of the practice of the four flexibility mechanisms specified in the Kyoto Protocol.

Under certain circumstances, in the course of the fulfilment of a commitment, substantial income may be channelled from a country that has already carried out a number of emission-cutting measures and thus has low unit emission ratios, towards countries that have taken practically no steps to reduce their emissions, as a consequence have high unit ratios, and can carry out a variety of low-cost emission abatement measures.[5]

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[5] The paradox of the Kyoto undertakings: countries with economies of relatively low carbon intensity will pay countries with economies that are much more carbon intensive, for, in the course of the increasingly likely international trading of emission permits, according to the majority of the relevant models, Japan and the EU will purchase emission abatement from the US and Russia (see, for instance, Ciorba et al., 2001). As a matter of course, a number of structural impacts – such as the contributions of the various sectors to the gross domestic product of different countries – need to be taken into account. If a fundamentally carbon-dependent sector makes a large contribution to the GDP of a given country, the unit carbon ratios of that country will be high irrespective of the level of the unit emission of the given sector in comparison to the corresponding sectors of other countries. Indicators in a

The flexibility mechanisms

The Kyoto Protocol recognises four so-called 'flexibility mechanisms', which may be applied by the signatories to facilitate the fulfilment of their undertakings. The four mechanisms are: 'bubble', (Article 4.1 UNFCCC [1997]); joint implementation (JI), (Article 6.1 UNFCCC [1997]); clean development mechanism (CDM), (Article 12.2 UNFCCC [1997]); and international emissions trading (ET) (Article 17 UNFCCC [1997]). The bubble mechanism is already operating, as are the two bilateral project-based mechanisms that provide direct climate development investment projects for the host country, and the possibility of acquiring emissions avoided as a result of an investment project (carbon credit) through administrative intergovernmental agreements, for the investing country (CDM, JI). As a result of the development of a trading system based on tradable emission permits, the emission of all the greenhouse gases expressed in carbon or CO_2 equivalent is turning into an exchange-traded commodity. In principle, the Kyoto Protocol permits three types of GHG trading systems. The Protocol specifically mentions the transfer of allowances between states (international tradable allowances) but according to the text, trading systems within a given country (domestic tradable permits) and the international trade in emission permits (international tradable permits) are also regarded as acceptable.

Since the location of the emission of greenhouse gases does not make a difference from a global perspective, the climate protection investment possibilities do not compete with one another on the basis of the cost of abatement alone, within one flexibility mechanism. Rather, the flexibility mechanisms compete with one another: if the unit carbon cost of the savings that can be realised through a JI project are much higher than the market price of the tradable permits, then the JI plan finds no investor; if it is lower, the permits will not sell.

The future of the Protocol

If the US refuses to join, the goals of the Kyoto Protocol are not likely to be achieved. For the time being, even the Protocol's entry into effect is not certain because an insufficient number of countries have committed themselves to the scheme, and because the total GHG commitments may fall short of 55%. As this study is being finalised, it all hinges on Russia's decision whether the conditions for the Protocol's entry into force will be met. Even if it does come into force, the question will still remain as to whether the restriction on international carbon trading means the developed countries assume substantial costs without standing a chance of achieving reductions in excess of 2–3%, or whether they accept zero reduction at zero cost. In the first case, the actual impact of reduction on the climate will be

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sectoral breakdown contribute to the picture based on national aggregate ratios. In each of the sectors that are covered by the carbon-trading system according to the EU directive unit emission levels are always higher in the USA and Russia than in Europe or Japan.

negligible, but it will entail substantial costs for certain countries. In the second case, however, the start of actual reductions will be postponed for as long as there are surpluses in Eastern Europe. A number of countries are in a position whereby they may not even sell between 2008 and 2012 the surplus they have today because their GHG emission is growing at a rate that may not permit them to enter the international market as sellers. This will be especially true if the process of climate protection intensifies and a second compliance period takes shape for the period after 2012.

The climate policy of the European Union

Under the Kyoto Protocol the European Union undertook to reduce the 1990 level of greenhouse gas emissions by an average of 8% between 2008 and 2012. By applying the bubble mechanism and the principle of burden sharing, the EU – as a signatory to the Kyoto Protocol in its own right – was granted the right to redistribute the 8% reduction among its member states. In this way the EU has to fulfil its undertaking at a community level, which allows greater cost-effectiveness within the European Union and the undisturbed continuation of the cohesion policy aimed at accelerating and deepening the economic integration of the member states. The following table shows that within the 'EU bubble' some member states assume the obligation to carry out substantial reductions in emissions 'free of charge' from countries with less well-developed economies (Greece, Spain, Ireland, Portugal); that is, in the form of non-fiscal support implemented in the framework of the European cohesion policy.

Table 1. Burden sharing within the EU bubble

Emission reduction undertaken under the Kyoto Protocol as a percentage of the 1990 emissions, in the 15 EU member states	
Belgium	92.5
Denmark	79
Germany	79
Greece	125
Spain	115
France	100
Ireland	113
Italy	93.5
Luxembourg	72
Netherlands	94
Austria	87
Portugal	127
Finland	100
Sweden	104
United Kingdom	87.5
European Union	92

Source: Council Decision of 25 April 2002; Official Journal of the European Union (2002).

Today's forecasts are more or less in agreement that, without a change in the trend of emissions, EU CO_2 emissions between 2008 and 2012 will, on average, exceed the 1990 level, and consequently steps will have to be taken to modify the trend of the basic processes if the Kyoto undertaking of an 8% reduction is to be met.[6] There is a growing commitment inside the EU to meet it. At the negotiation rounds in Bonn and Marrakech the Kyoto process was only saved by the resolute stance of the European Union. In 2001 the Community confirmed its intent and ensured the survival of the Kyoto Agreement after the failure of the round of negotiations in The Hague, through its resolve and its willingness to compromise in Bonn and Marrakech. In parallel, at the Community level, an internal package of measures was adopted concerning EU member states, with the aim of meeting the emission

[6] Commission Staff Working Paper: Third Communication from the European Community under the UN Framework Convention on Climate Change, 30 November 2001; downloaded in September 2002 from the following site: http://unfccc.int/resource/docs/natc/eunc3.pdf

reduction targets prescribed in the EU bubble, should the Kyoto Protocol fail to come into force.[7]

The 'increasingly serious' European climate protection strategy will have a major direct and indirect impact on Hungary's carbon emissions. On the one hand, with its huge potential volume, the European CO_2 trading scheme, which covers the overwhelming majority of emissions, will obviously result in a stable market price for CO_2. This will naturally determine the carbon price that will come to prevail in the Hungarian market, just as it will influence the price of CO_2 that may be sold 'in the market' of other Kyoto mechanisms as well. With respect to its market-related aspects, the most important fact is that EU member states will be seeking a substantial quantity of carbon dioxide on the markets, in part on their own internal community markets, but also, to a significant degree, on the international carbon markets. The total carbon dioxide emissions of EU member states in 2010 is forecast to be some 3,457 million tonnes a year (COM[97]514) (baseline scenario). If this needs to be reduced by some 7.5% in real terms in order to meet the EU's Kyoto undertakings, then additional CO_2 emission permits for approximately 259 million tonnes will be required on average each year in the five years between 2008 and 2012, to be achieved through domestic measures or from the stocks of the Kyoto allowances of other countries ('Assigned Amount Units' or AAUs). Accordingly, (apart from domestic measures) the minimum quantity that the EU-15 member states intend to purchase in the market will amount to *a total of 1,300 million tonnes of CO_2*. Today's CO_2 prices vary widely: *at present*, in bilateral transactions concluded for high-quality carbon credits (reliable, authentic source and large volume) the *price of one tonne of CO_2 varies between 4 and 9 Euros*.[8] The integration and the increasing transparency of markets are expected to lead to declining prices, but the huge

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[7] This climate protection package comprises three main elements:

Communication from the Commission on the implementation of the first phase of the European Climate Change Programme (COM[2001]580) – in this document the Commission reports, among other things, that the institutional obstacles are being removed to enable implementation of negative-cost energy efficiency investment projects;

Proposal for Ratification of the Kyoto Protocol by the European Community (COM[2001]579) – in this document the Commission laid out its proposal that, by the World Conference on Sustainable Development scheduled to take place on the 10th anniversary of the UN Climate Conference in Rio, i.e. by August 2002 – the member states should have ratified their Kyoto commitments, i.e. they should have integrated their commitments into their national legislation (Rio Plus 10);

Proposal for a Directive of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community (COM[2001]581) – according to the proposal, the quantity of carbon dioxide that may be emitted by a specific group of enterprises shall be embodied in tradable emission rights from year 2005. The total quantity of such permits should be fixed by the member states in accordance with their own undertakings, but CO_2 trading will also be allowed among member states. (For a detailed analysis of the Directive, see below).

[8] For example, see the home page of the JI agency of the Dutch govt: www.carboncredits.nl

demand will drive prices upwards.[9] Based on an assumed price of 5 Euros the *European carbon market alone is estimated to be worth some EUR 6.5 billion*.

On the other hand, it has long been recognised in the European Union that there is a need for an appropriate carbon cost to be applied throughout the economy, to prevent 'leakage' in some sectors, while other sectors of the economy spend substantial amounts on constraining CO_2 emissions. For this reason, a number of countries have already transformed their taxation regimes to take account of climate protection requirements. On the whole, it may be concluded that there is a good chance of a single system of carbon taxation in the European Union, and this should be carefully monitored by Hungary, as a country preparing for accession.

The EU's CO_2 emission trading directive

The early stance taken by the EU on the trading of emission allowances has gradually changed. After its initial firm rejection, the Community position has gradually 'softened' and some member states are already operating GHG trading systems (such as the United Kingdom and Denmark). In October 2001 the European Commission approved the draft directive on mandatory implementation of emission trading in GHG (COM[2001]581). In January 2003 the Council of Ministers came to a political agreement on the modifications to the original draft of the Commission (COM[2002]680) proposed by the European Parliament, and in autumn 2003 the Directive came into force (Directive 2003/87/EC). The key elements of the Directive are: establishment of a limit on the quantity of emissions and free tradability below this limit (cap-and-trade), mandatory participation, legal enforceability to be ensured, and penalties for non-compliance. This section will review the regulatory and institutional details of the Directive.

Regulatory tasks, system of institutions

The Directive imposes important regulatory tasks on the governments of the member states in two ways. On the one hand, it calls for the application of a brand new regulatory instrument, quite unknown to the majority of member state administrations. On the other hand, it provides for the initial distribution of part of the CO_2 emission permits. This will appear in the form of a privatisation decision entailing the transfer of valuable rights.

[9] Current estimates assume zero or almost zero price in the case of the free sale and purchase of the Russian and Ukrainian carbon surplus (hot air) and the abstention of the USA.

The emissions of enterprises concerned

Enterprises with a specific minimum output capacity in five sectors fall within the scope of the Directive. The power sector – with its substantial emissions that account for at least half of the total CO_2 load and its small number of point sources, together with the ease of its regulation – is the focal point of the Directive. The Directive covers practically all power plants, since it applies to all furnaces with an input heat capacity exceeding 20 MWth. This corresponds to a power capacity of about 6–8 MWe.[10]

Some 4–5,000 enterprises are thought to be subject to mandatory participation, through which some 46% of the total CO_2 output of the European Union will be regulated. In this way the Directive may be definitely regarded as substantive and tough, though not totally consistent. Three very important sectors – the chemical industry, the aluminium industry and the transport sector – seem to have been left unaffected. The chemical industry and the aluminium industry seem to have a substantial potential to reduce GHG emissions, and it is expected that they will be drawn within the scope of the regulation. The GHG emissions of transport are also growing steeply, but their regulation is complicated by both technical and political considerations. Administrative effectiveness was one of the goals behind the design of the regulation, and therefore the groups of enterprises covered by the Directive are identical to those covered by the EU Directive on Integrated Pollution Prevention and Control (IPPC). According to the Directive, the enterprises of the sectors concerned are expected to save some 35% of the relevant costs – about EUR 1,300

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[10] Operations covered by the Directive:

Energy activities

- Combustion installations with a rated thermal input exceeding 20 MWth
- Mineral oil refineries
- Coke ovens

Production and processing of ferrous metals

- Metal ore roasting or sintering installations
- Installations for the production of pig iron or steel with a capacity exceeding 2.5 tonnes/hour

Mineral industry

- Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes/day or lime in rotary kilns with a production capacity exceeding 50 tonnes/day
- Installations for the manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes/day
- Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, stoneware or porcelain, with a production capacity exceeding 75 tonnes/day

Paper industry

- Pulp from timber or other fibrous materials
- Paper and board with a production capacity exceeding 20 tonnes/day

million a year – in comparison to a regulation that resulted in similar emissions abatement without trading in permits.

Of all the greenhouse gases, only CO_2 falls within the scope of the Directive. The Commission will draw up a proposal first by 31 December 2004, and then by 30 June 2006, for the scope of the Directive to be extended to the other greenhouse gases listed in the Kyoto Protocol.[11]

Permit vs. allowance

According to the Directive, the member states are obliged to provide GHG emission permits for a certain group of companies, setting out clearly that each permit holder must have an allowance of a quantity that corresponds to the quantity of its GHG emissions. However, in addition to the obligations, an emission permit also provides rights for the regulated companies, for an emission permit entitles the holder to the amount of emission allowances determined by the state in accordance with the allocation mechanism prescribed by the legal regulations in effect. This may, in certain cases, be a right of a very high value, because, if the existing emissions are allocated free of charge, this could provide a very significant source of income for enterprises with emission permits. The enterprises that do not have GHG emission permits at the time the national allocation plan is drawn up will not be entitled to the allowances allocated by the state under such favourable conditions. If their operations are covered by the regulation, they will need to purchase allowances in line with the quantity of their emissions, in the secondary market for allowances. The only exception to this may be where, at the time of initial allowance allocation, the state sets up a separate pool for new entrants to the sectors concerned (see below).

An emission permit may not be transferred: it is valid for a given facility, polluter or company, and is one of the institutions of the regulation. Tradable emission rights are defined by the Directive as emission allowances. An emission allowance is a certificate similar to a securities bond, and it proves to the authorities (national registry) that the holder of the allowance has released a given quantity of GHG (expressed in terms of tonnes of carbon) legitimately during the given period.

[11] This would be highly important for Hungary, particularly with respect to methane and dinitrogen oxide:

- Methane (CH_4)
- Dinitrogen-oxide (N_2O)
- Fluorinated hydrocarbons (HFCs)
- Perfluorcarbons (PFCs)
- Sulphur hexafluoride (SF_6)

Emission permit	Emission allowance
'Permit'	'Allowance'
This is valid for a given entity, facility	This is valid for the emission of a tonne of CO_2
Not transferable	Freely transferable
The entity must not operate without this	The permit holder must not emit CO_2 without this
It contains monitoring, reporting and verification obligations	Uniform EU-wide definition
Imposes obligations on the holder to submit an 'allowance' that corresponds to the quantity of its annual CO_2 emissions	It must be recognised by all member states
It does not contain an emission limit value	It may be purchased by any natural or legal person
Allows sanctions to be applied; is a requirement for the operation of the institution	It is issued and cancelled by the national authority
	It must be kept in the national register

Validity of the emission allowances

Allowances issued by any EU member state under conditions that comply with the Directive must be recognised by all other member states. This will turn the allowances into a uniform exchange-traded commodity across Europe.

The Directive provides for two trading periods: a three-year period between 2005 and 2007, and a five-year period between 2008 and 2012. Furthermore, the Directive makes several references to the subsequent five-year periods as the dominant regulatory frameworks. Mandatory regulation concerning the first period is based primarily on the Commission's concept, rather than on the Kyoto undertakings of the member states, since the targets relate only to the average of the five-year period beginning in 2008. Nevertheless, the Commission has adopted an introductory period, during which somewhat easier conditions apply. The declared objective for the period between 2005 and 2007 is preparation for the actual period of compliance. The directive assigns to the individual member states the right to decide whether emission permits may be carried over from the introductory period to the second period (between 2008 and 2012); in other words, whether continuity of ownership rights acquired between 2005 and 2007 should be provided for the regulatory period beginning in 2008. Unused emission allowances acquired during the period between 2008 and 2012 can, according to the legislator's intent, definitely be carried over to the next regulatory period.

Allocation

The member states will have to produce allocation plans for approval by the Commission. An allocation plan should contain the total quantity of all the allowances and the mode by which the allowances are allocated. The Directive expects eleven criteria to be satisfied by the allocation plan, though some contradict others. The most clearly conflicting principles are as follows:

- taking into account the best available technologies and the resulting CO_2 emission reduction potential;

- taking account of the actual emissions and the previous emission reductions before the allocation.

In view of the competition policy references in the text, no single company may be granted more emission allowance than is needed for its continued undisrupted operation: violations of this principle will be prohibited by the Commission as illegal state aid.

According to the text of the Directive, some 5% of the allowances to be allocated in the first regulatory period may be transferred by a member state to the companies concerned through auctions. In the second period (the 'live' Kyoto period), this proportion will be 10%, but the Commission will draw up a proposal for a harmonised allowance allocation scheme for the whole of the Union, by 30 June 2006. It will be a task for the member states to pass legislation to provide subsequent new entrants with emission allowances. Thus individual detailed rules may be drawn up.

It should be noted that the Commission does not intend to have a say in the quantity of GHG allowances to be allocated by the member states. Only one flexible restriction is applied, by which the total quantity of allowances 'should be consistent' with the Kyoto quota undertaking. Any member state may, however, decide to restrict the total emissions of the sectors concerned in a way that is different from its Kyoto undertaking, by reducing the total quantity of allocated allowances. After the initial allocation of allowances, anyone may participate in trading, i.e. any natural or legal person may purchase allowances. Within the period, and among the EU member states, there will be no administrative obstacles to trading, in keeping with the principle of free movement of goods and capital. Information on the allocation mechanisms and their effects will be presented in more detail in the related study No. 2.

Monitoring, reporting, verification, submission and cancellation of allowances

Compliance is achieved through a complex administrative process. An emission permit also sets out the reporting and monitoring rules. Monitoring may be carried out through calculations or measurements. A permit holder has to report its CO_2 emissions to the national authority at the end of each year. The contents of the

reports have to be proven by an audit in a professionally sound report produced by an independent expert (verification). A quantity of allowances matching the actual annual CO_2 emission has to be submitted – surrendered – to the authority of the member state in which the entity's plant is operating, by 31 March of the year following the year concerned, together with the verification audit produced as described above. The allowances submitted by companies are cancelled by the authority. Cancellation may be requested at any time (electronic registration of allowances).

Sanctions

Each tonne of CO_2 by which the permit holder's emissions exceed the quantity of allowances surrendered, will incur a penalty. In the first period, the amount of the penalty will be 40 EUR/t, and in the second period it will equal 100 EUR/t. The missing quantity of allowances must be surrendered in the next year. Accordingly, failure to surrender the necessary quantity of allowances is an expensive mistake.

The original proposal of the Commission specified a different sanction: it would have been worth purchasing allowances on the secondary market at any price, rather than paying the penalty, for there was no ceiling on the amount of the penalty. It could not be below 50 EUR/t and 100 EUR/t in the first and second periods, respectively, but if the price of allowances on the market exceeded half this amount, the penalty would have equalled twice the amount of the market price. This would have led to compliance at uncertain but probably higher costs. This technique of sanctioning could be criticised for its uncertainty. This could have been prevented, for example, by insisting that, instead of the higher of 50 EUR/t and the average market price of CO_2 emissions in the preceding year, the lower of the two could be imposed as a penalty. In this way the cost of compliance would have been limited from above, even if the permit holders did not have a sufficient quantity of allowances for their emissions. In contrast to a flexibly growing penalty, which guarantees that the emissions do not exceed the quantity of allowances, the disadvantage of a fixed penalty is that the quantity of the emissions becomes uncertain, for the price of the allowances may reach the amount of the penalty.

A summary of the authorities' tasks

1. The competent authority or authorities delegate responsibility for:

   - Issue of permits
   - Allocation of allowances
   - Monitoring
   - Reporting and verification
   - Sanctioning (penalty)

2. The National Registry is responsible for:

   - Account keeping
   - Registration of commercial transactions
   - Cancellation

3. There is a maintained national GHG inventory.

Evaluation of the EU CO_2 Emission Trading Directive

The importance of the Directive lies primarily in transferring the right of CO_2 emission from the realm of freely accessible public goods to the category of factors of production of limited accessibility. The most potent provisions of the regulation may be summed up in two points. Firstly, it determines for companies in five economic sectors what the newly defined ownership rights cover after they have acquired the emission allowances. The other fundamental achievement of the regulation is the removal of most of the transactional restrictions among the 25 member states to enable free trading in these ownership rights. The following is an evaluation of the provisions of the Directive concerning ownership rights, allocation and control. Attention will be drawn to certain important market-related effects of the development of the trade in allowances.

Ownership rights

The essential role of the definition of ownership rights in relation to external effects has been analysed in a substantial volume of theoretical literature ever since Coase (1960). According to theoretical considerations, the inefficient environmental status is caused by the lack of identification of ownership rights, and therefore how the Directive defines ownership rights is the key to resolving the regulatory task. H. Demsetz (1964) regards the actual attributes of ownership rights to be important and emphasises the importance of the enforceability of such rights from the perspective of economic analysis of ownership rights. Accordingly, it should be pointed out that the Directive imposes a substantial restriction on the actual attributes of the emission rights: there are spatial and temporal restrictions on disposal of the emission allowances. The emission allowances may only be sold in the EU member states, and there is no provision for the existence of ownership rights in an unchanged form over a longer period of time. The regulator is not obliged to provide the rights (allowances) granted for the three-year period between 2005 and 2007, for the period beginning in 2008. During the subsequent five-year period, the emission allowances may, in principle, be freely reallocated but, according to Annex III, the member states have to distribute the allowances that embody the emission rights in each year to the regulated companies in proportion. Even if this is guaranteed by the regulation in principle, it still does not provide complete ownership rights, because a company does not receive the whole of its allowances for the five year period at the beginning

of 2008, and thus it may not use them in its own hedging transactions; it may not use them to raise funds; and may not regard them as part of the company assets. In principle, the member states are obliged ('shall issue' Article 13.3) to provide for the existence of emission allowances held by companies in 2012 for the subsequent regulatory period, as well. The authenticity of this is essential, since the benefits of the CO_2 emission-reducing investments will depend on the number of years during which the company is entitled to sell allowances corresponding to the reduction in emissions. This issue is discussed in more detail in our related study No. 2. Another uncertainty inherent in Annex III is whether a company that terminates its operations may freely dispose of its emission allowances: whether it may sell them off, just as it sells its assets. On the whole, however, a company that conducts its normal operations may freely decide whether to retain or sell the emission rights it has acquired and, accordingly, it has a right to the benefits originating from ownership.

Allocation

H. Dales (1968) was the first author to formulate the theory that the ownership rights that may be defined with respect to natural resources considered to be 'scarce' (such as the CO_2 absorbing capacity of the atmosphere without climate change) should be allocated to those who are willing to pay the highest price for them. The Directive provides a formal possibility for a small (5 or 10%) proportion of the total quantity of allowances to be auctioned. Baumol and Oates (1988) point out that the loss of efficiency that results from a departure from initial auctioning is compensated for by the fact that the political chances of successfully introducing the regulation are enhanced by the allocation of allowances free of charge, since that provides a more acceptable initial situation for the companies concerned. The question is what effect the auctioning of this limited quantity of allowances will have on the effectiveness of the regulation. In our view, the auctioning of 10% of the allowances may be enough to combine the advantages of quantitative and economic regulation (to be described in more detail in our related study No. 2).

In principle, the fastest way of distributing ownership of the emission allowances, to equalise the marginal costs of emission abatement in the regulated sectors, is by auction. Such a process of levelling of marginal abatement costs, however, may also take place where the initial distribution of the allowances is not efficient, but the bargaining process and the transactions are relatively free of costs.[12] According to this view, the Directive may be regarded as consistent since, in parallel with the definition and allocation of the emission permits, it provides for universal recognition in each of the 25 member states and stipulates that free trading may only be restricted in the case of forward transactions. This will provide a real chance to

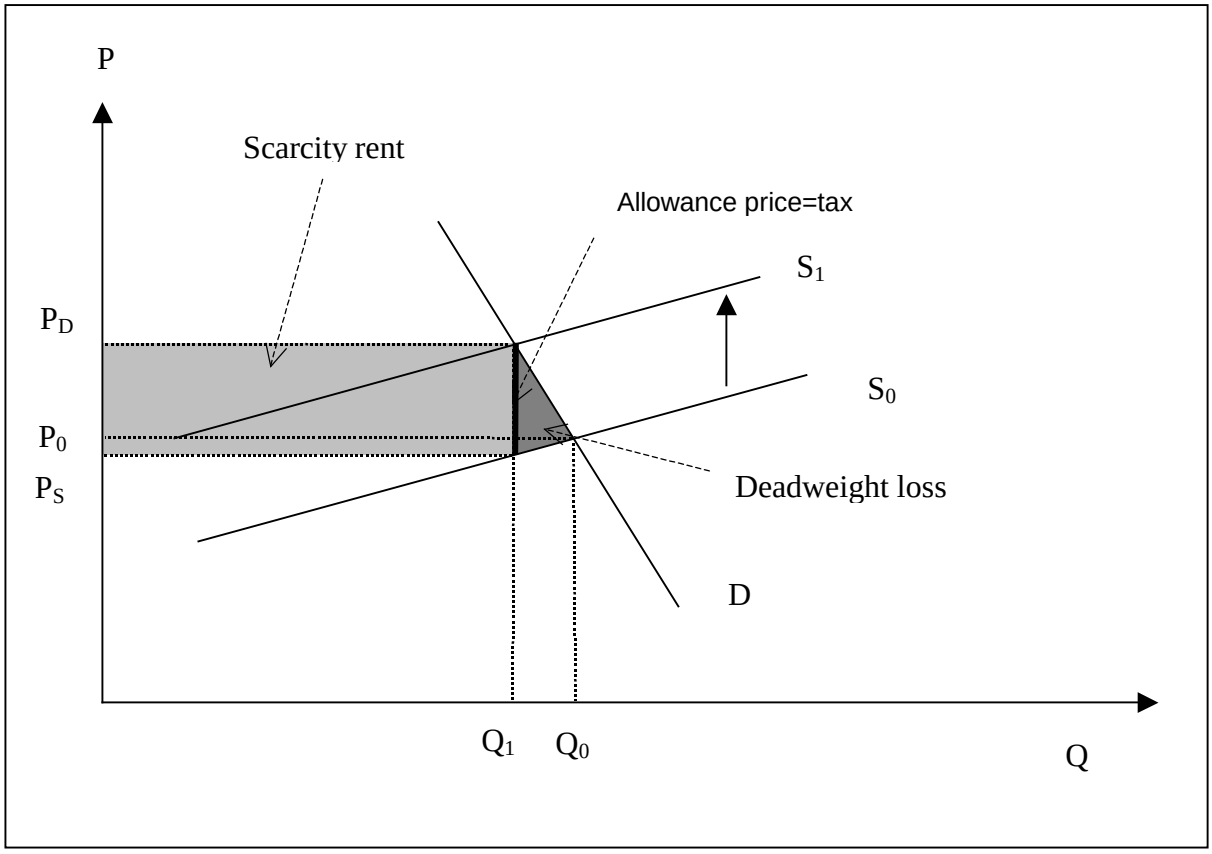
[12] There is a strict interpretation of the Coase theorem, according to which the outcome of the bargaining process will not be independent of the initial establishment of ownership rights, only the Pareto efficiency of the outcome may be expected in the case of zero transaction costs. (Szakadát L. (1995); H. Varian (1995), pp 649.)

level the simultaneous differences in the costs of abatement, but the cost-cutting effects of long-term investments and emission-reducing innovations remain questionable.

P. Cramton and S. Kerr (2002) reviewed the effects of the different mechanisms of distributing the CO_2 emission allowances on the distribution of incomes. Their basic theoretical assumption is that the restriction of CO_2 emissions – in other words, carbon regulation – creates scarcity in the economic sectors concerned. Scarcity creates rent, the distribution of which is a complex regulatory task. They reviewed the issue on the basis of the following figure.

If regulation is to bring about a certain reduction in carbon emissions, and if to this end it intends to reduce total consumption in the market of a given product from Q_0 to Q_1, the original P_0 equilibrium price will increase to P_D. This is what the consumer will have to pay, but the manufacturers will only receive P_S in sales revenue. The difference between the two is the tax on carbon emissions falling on quantity Q of the given product, or the price of the tradable emission allowances.

Figure 5. The scarcity rent, the deadweight loss, distribution and price effects originating from the introduction of carbon regulation



Source: Cramton and Kerr (2002).

The above price changes will come about through any type of carbon regulation: a given level of carbon allowance or an equivalent carbon tax will result in the same level of rent (based on perfect information), as is indicated in the figure by the light grey area. The regulation will, however, determine who the rent will be enjoyed by. If a tax is applied, the rent is collected by the state. The same applies if all the allowances are auctioned. If, however, emission allowances are distributed by the state free of charge, the scarcity rent is handed over to a preferred group of entities. Cramton and Kerr argue that this is not simply a political question; indeed, for economic considerations, if carbon emission is to be regulated by emission allowances rather than by taxation, then the allowances should be distributed at auction rather than just handed over free of charge.

Alleviation of the existing distorting effects of taxation is a permanent task for the state's taxation policy. The figure clearly shows that the introduction of carbon regulation also results in distortion: the deadweight welfare loss marked by the dark grey triangle is a real loss both to consumers and manufacturers (as well as to the state). If the area of the scarcity rent is state revenue, it would clearly provide sufficient funds for adjustments to demand or supply (in some form of compensation or tax alleviation) to reduce the social deadweight loss. Furthermore, the expected permanent nature and huge volume of the carbon rent (since the economy is going to be substantially carbon-dependent for quite some time to come) makes it a suitable means of raising revenue for the state, to enable it to reduce other taxes that have distorting effects. If carbon regulation first compensates the deadweight loss of the carbon market, then it will be capable of providing continued state revenue without distortions. According to some research – quoted by Cramton and Kerr – one tax dollar in the US costs approximately $1.3, taking into account the costs of the effects that distort the market. Accordingly, a significant part of the rent could be withdrawn from the carbon market at zero cost (this is the subject of the so-called 'double dividend' debate: for more details see, for instance, Goulder, 1997).

The distribution of rent and the price effects jointly make up the distribution effect. The rent is created by the establishment of ownership rights: in the case of taxation or the auctioning of all the emission allowances, the ownership of carbon emission is transferred from the category of public goods into the ownership of the state (i.e. the taxpayers), while allocation of the allowances free of charge will turn the emission right from a public good into the private property of a preferred group. The price effects are determined by the relative slope of supply and demand that characterise the given market. Prices will increase faster where flexibility is less extensive. In the above figure a larger part of the funds collected by the state through carbon taxes would be paid by consumers (part of the grey rectangle above P_0) than by sellers (the part below P_0). As a matter of course, the figure will change both in the short and in the long run. Capital investment and labour are both inflexible in the short term. In the longer term, however, both the capital market and the labour market are flexible and will adjust their supply to the new carbon regulation. For this

reason, consumers will bear the costs of carbon regulation in the longer run.[13] This is not elaborated on by Cramton and Kerr, but it also follows from the above that prices will also increase in competitive markets if producers are granted emission allowances free of charge in one country and for a price in another. In this case the state allocating the allowances free of charge grants the emission right to the producers, who will then collect the whole amount of the scarcity rent from the consumers. If the companies perceive an opportunity cost to the allowances allocated free of charge, the above statement will also hold true if all companies are granted emission rights free of charge. On the whole, therefore, the allocation of all the emission allowances against payment of money (in the form of a carbon tax or auctioning of all the allowances) will ensure the most efficient allocation of the scarcity rent.

One more argument is often quoted in support of grandfathering, that is the granting of emission permits free of charge to entities that have been responsible for CO_2 emissions beforehand: it has a favourable effect on the competitiveness of the companies concerned. We have seen that the development of a given amount of carbon rent results in the same deadweight loss regardless of whether the rent is owned by companies or the state. According to Cramton and Kerr, while state ownership of the rent may provide a source of income for the alleviation of the deadweight loss (e.g. compensation of demand or supply), the transfer of the rent to companies will result in a loss of competitiveness owing to the uncompensated deadweight loss. In our view, this is an empirical question: it should be seen in each individual case whether there is a level of competition that would prompt companies to invest the benefits originating from the rent, into their supply. If this takes place in a competitive market, the allocation of allowances free of charge will have no adverse effect on competitiveness; indeed, it may even improve the relative competitive position of companies. At the same time, the rewarding of past emission by allocating an allowance free of charge will not actually reveal anything about the longer-term marginal costs of a unit of carbon emission. Nevertheless, their relation to the long-term marginal abatement cost will express the impact of the introduction of carbon regulation on the competitiveness of the individual company. New entrants in an industry will bring with them technologies that are chosen and designed with a view to the existing and expected CO_2 emission costs. If the cost is higher than zero the new entrants will enter the market with more CO_2-efficient technologies than those companies already in the market. Therefore, free allocation of allowances (grandfathering) is definitely not a general panacea for the declining competitiveness of certain companies in the case of marginal costs of CO_2 emission that are positive in the long term.

[13] What distribution effects should be expected in the Hungarian power market is an empirical question that goes beyond the scope of this study.

Control and compliance

Since the effectiveness of regulation is expressed in this case in the realisation of the emission level prescribed by the state, instead of the emissions agreed on between the parties concerned, assessment of the means of control and sanction is also important. According to the Directive, the costs of control and compliance should be shared between the state and the companies concerned. The prescribed level of the penalty (50 and 100 EUR/t) seems to be high enough,[14] but the weight of the penalty is, of course, only one side of the effective cooperation of companies. According to the 'crime and punishment theory' of Becker (1968), we know that – besides the amount of the penalty – compliance with the rules also depends on the likelihood of the infringement being detected. If the benefit from infringement is in excess of the expected sanction, it is worth bypassing the regulation. In theory, if a company is risk-neutral and the likelihood of the irregularity being proved is p, the amount of the penalty to be imposed f is a positive function of the extra pollution v, the company will find it worth exceeding the permitted emissions so long as $g \geq f(v)*p(v)*v$, i.e. so long as the benefit reaped through fraud exceeds the expected amount of the penalty. (Harford, 1978; Milgrom and Roberts, 1992).

The success of the US SO_2 trading system has partly been a result of the effective operation of an efficient monitoring system. On the one hand, it provides real-time information on the quantities released, supplied by a monitoring system – installed on a mandatory basis – which detects the quantity of the emitted pollutants on an ongoing basis. Furthermore, companies that cannot cover their emissions with a sufficient quantity of emission allowances have had to pay a very heavy fine of 2,000 $/t, and the officials held responsible for the violation have been liable to criminal proceedings.[15] This high penalty rate increased the cost of bypassing the regulation and minimised the opportunistic inclinations of the companies concerned (IEA, 2001).

By contrast, the EU Directive fails to impose an obligation concerning measuring of CO_2 emissions. According to Annex IV of the Directive, the quantities released by the various sources may be established by calculations or measurements, but the results of measurements also have to be supported by calculations based on accepted methodologies. Calculations must be carried out using operation-specific emission factors established for each of the fuels used. According to Annex V, which contains the regulations concerning the verification procedure, review of the reports issued by the various polluting companies and control will be carried out by an independent verification organisation, which will review the reports and make onsite inspections where necessary. If the costs of verification are borne by the companies, it leads to a situation where the regulated party bears a substantial part of the monitoring costs, and this could lead to a distortion of the effective pollution

[14] In comparison to the preliminary estimates of 5–25 EUR/tonne allowance prices.

[15] The price of SO_2 emission permits was 70 $/tonne in 1996 (IEA, 2001, p. 31).

abatement cost structure. With verification paid for by the regulated party, an agency problem may arise between the verifying organisation and the regulating authority; however, if the state puts together a list of eligible verifying organisations, the efforts made by these organisations to preserve their reputation may alleviate the problem.[16]

Harrington (1988) sought an answer to the question of why the majority of companies observe the obligations resulting from the regulation, despite the fact that after 1978 the frequency of inspections was low in the USA and fines were imposed only rarely, even when infringements were detected. Harrington assessed the behaviour of companies in the case of environmental regulation, in a dynamic game theory model. He found that observing the obligations originating from regulations is in the interests of a company, even if the costs of compliance exceed the expected amount of the penalty in certain periods. His findings are in line with the conclusions of models that emphasise the impact of reputation as a factor that reduces moral hazard (Milgrom and Roberts, 1992). The propensity to infringe rules, therefore, is also influenced by the fact that climate regulations have been introduced for the long term, and if a company has broken the rules it may expect increased attention from the regulating authority in later stages. (In the case of power plants approaching decommissioning the moral hazard will, of course, increase – the so-called 'end of game' problem – and this issue is not tackled by this Directive either.)

In the case of power companies, supervision is facilitated by the fact that the system operator has precise, real-time information on the power released by the companies into the grid on an ongoing basis; accordingly, if their fuel use can also be controlled with an acceptable degree of precision, controlling is an easy task based on technology.

Market effects

In respect of the prospective market for allowances, attention should – based on Tietenberg (1985) – be paid to two phenomena that may stem from the Directive. From aggregation of the empirical research findings of a variety of operating emission trading systems (NO_x, phosphorus, SO_2), Tietenberg draws the conclusion that the initial allowance allocation mechanisms that reduce the quantity of the allowances allocated to individual companies in proportion to the original emissions do not take account of the effect of what is referred to as 'economies of scale', which is also functioning in the case of emission-reducing projects. Entities that emit large quantities of a pollutant can reduce a larger share of their emissions at a lower marginal cost than those that emit smaller quantities. This results in a market situation where a few large companies supply the market with emission allowances, and almost all smaller entities are buyers on the same market. If these companies are also competing in the market of their core products, attempts to enforce market

[16] Though it may turn out later that it is more worthwhile for such verifying organisations to invent 'creative carbon accounting' techniques and sell them to companies...

power by means of the emission market are to be expected. For this reason, governments should prepare for a combined manipulation of the power market and the CO_2 emission allowance market through the pooling provisions of the Directive and the expansion of large European energy corporations. In the case of certain grid congestions, and during peak demand periods, this may lead to a reduction in production and an implicit barrier to market entry.

Tietenberg (1985) has also generalised another observation concerning the markets in allowances. In the market of the emission of CFCs – chlorofluorocarbons – brought under regulation after their harmful effects on the stratospheric ozone layer were recognised, a typical cost difference developed between industries and companies in the early eighties. The enterprises of some industries massively reduced their emissions and the allowances allocated to them were purchased consistently by the same entities. This phenomenon should be explained by substitutability. For the companies that became net allowance sellers were those in whose technologies CFCs could be replaced with other materials (flexible foams, solvents, etc.) at low cost. The enterprises in whose products or processes CFCs could not be replaced or could be replaced only at high cost (rigid foams, liquid coolants, etc.) steadily purchased the emission allowances. In the case of CO_2, a similar asymmetry is expected to develop between high-efficiency natural gas-fuelled facilities and low-efficiency outdated facilities, for the Directive promotes grandfathering-type allocation. It is practically impossible to reduce the unit emission of a combined cycle gas turbine any further. In the case of such power plants, an allowance needs to be purchased for each additional unit of production. By contrast, coal-fired power stations can substantially improve the CO_2 efficiency of their operations, and accordingly they may be net sellers of allowances if their output is not changed; but even to increase their output they do not have to purchase allowances, if they are granted allowances that correspond to their original emissions. This phenomenon will go some way to balancing the increasing competitiveness of natural gas, in a natural way.

There is a danger in the Hungarian power market that the above two phenomena, i.e. the effects originating from the differences in efficiency and those originating from the economies of scale, may combine. This would lead to a situation where, as a result of the combined effect of the two phenomena, natural gas-fuelled facilities that operate with higher or lower degrees of efficiency need to purchase emission allowances from old power plants that are larger in size and operate at lower levels of efficiency. For this reason any allowance-based regulation will have to pay special attention to this possibility, to be prepared for unintended situations of dominance in the market. The best protection seems to be offered by international sale and purchase of allowances in the EU-25 countries at the lowest possible transaction costs.

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