

Economic instruments at the service of atmospheric pollution control – The case of tradable permits

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Introduction

Environmental policies in Europe, at both national and community level, are not based on economic reasoning and approaches. They are the result of a combination of positivist, or even scientific approaches used in the natural sciences and engineering approaches, of legal expertise dominated by administrative law, of ecological activism and sensitivity to lobbying by professional circles affected by environmental policies in the form of constraints or spending, like industry and farming. Conventional regulatory approaches aimed at dictating or constraining the technological choices of decentralised agents form the basis of these command and control policies, even if in practice, a certain flexibility is introduced discreetly through exemptions and tolerance of non-compliance with public standards. Outside the mainstream policy, approaches which are more flexible, but also less clear-cut in terms of impact, have been proposed more recently, like support for voluntary certification of environmental management systems (EMAS) or commitments negotiated with the authorities.

The 1996 directive on integrated pollution prevention and control (IPPC) is a recent example of such an interventionist approach. The aim of integrating actions for the protection of different milieus, obviously welcome to avoid wrong solutions, is represented in it by the conventional technological planning model. The opportunity that this theme of integration represented of developing an economic approach to pollution problems was not taken. It sets detailed limits using the concept of Best Available Technology. No place is given to economic reasoning in determining the choice of the right goals (zero pollution is presented as a desirable result, constrained only by "possibilities") and the system leaves very little room for the deployment of economic instruments, like incentive taxes or tradable permits, aimed at dividing pollution reduction efforts among the sources effectively.

This being the case, it can hardly be expected that the arguments of the OECD, the European Commission or top government politicians in favour of developing economic instruments in the area of the environment will find an application corresponding to their potential. For this, the system of concepts and rules built up over the last thirty years would have to be rethought in depth. In any case, the right solution will not be to add a few economic instruments to an existing regulatory system, which, by its very nature, will prevent these new instruments from functioning fully and bringing the gains in economic efficiency which justify their introduction.

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Experience has shown that in most cases (local problems affecting health and nuclear safety being among the exceptions), there is virtually no hope of reaching economic efficiency in the application of environmental policies without using economic instruments. Neither the traditional regulatory command and control approach nor voluntary agreements can provide both the required flexibility and the right incentives for reaching the objectives set in an economically efficient way. Hence the question “how can we achieve economic efficiency?” generally needs to be reformulated as “how can we design policies based on economic instruments and avoid their becoming mere systems for collecting budgetary resources, at the expense of their intended use as incentives, or the means of distributing a secure income to certain interest groups?”

This is the background to this article which firstly deals with what economic instruments are and then focuses on tradable permits, an economic instrument that has been used in the United States for nearly twenty five years, but is still virtually unused in Europe, despite the debate and reflection aroused by global climate risk management².

1. What are economic instruments?

The first section seeks to clarify what economic instruments are, while the second points out the two main misunderstandings surrounding them.

1.1. The two branches

Environment policy economic instruments³ are divided into two main areas: taxes and licence fees, on the one hand, and tradable permits on the other. The basic properties of these two branches from the point of achieving efficiency are similar. Both are based on a price mechanism, which aims to pass on appropriate economic information to decentralised agents about scarce environmental resources and allow the information held privately by these agents to be put to better use, without making its disclosure to the administrative authorities necessary.

The economic world being one of prices and physical quantities which characterise the goods offered for trade, the two types of instruments are just two ways of introducing the goals of a policy into this world. With taxes, the authorities give a regulated price-signal and the agents adapt to it by the quantities requested; with tradable permits, the authorities give a quantity-signal and the agents adapt their choices by comparing and matching their needs, which results in a market equilibrium price. Under conditions of proper market operation and good predictability of the main determiners, both approaches lead to the same result, namely the same price-quantity equilibrium and the same final distribution of pollution reduction efforts. In either case, the reference price (unit tax or permit price) equalises the marginal costs of reducing polluting emissions or using resources by the various agents while ensuring an aggregate level of emission or resource use compatible with the constraint set by the authorities. Thus, in the eyes of economists, there is no reason to praise one of the approaches to the skies and treat the other as beneath contempt.

² In March 2000, the European Commission published a green paper on the organisation of an emission rights trading system to implement the commitments made under the Kyoto Protocol to control greenhouse gas emissions. Such a system could be introduced as of 2005.

³ For an empirical table of the financial and economic instruments in use in OECD countries until the early 90s, see OCDE (1994).

There are indeed appreciable practical differences and circumstances which favour the use of one rather than the other of these approaches. These differences must be taken into account when choosing an instrument to deal with a given problem. The empirical discussion which should take place depends essentially on four variables:

- *the nature of the environmental problem to be solved*: the local, regional or global nature of the problem determines the equivalences acceptable from the point of view of the damage between an emission of a pollutant at a point q and a point r and between a time t_i and a time t_j . Government taxation like that on fuels is a mass instrument, unsuited to regulating local situations, whereas tolls and licence fees can easily be differentiated and circumscribed; tradable permits suppose that the levels of emission from localised pollution sources can vary within the application perimeter due to trading without this resulting in additional damage. The same is true of time flexibility. If this was not the case, a system of zones and time periods should be introduced to define trading possibilities;
- *the existence of uncertainty on the functions of damage and pollution abatement costs*: when it is suspected that there are threshold effects in damage or that damage will increase rapidly according to the level of emissions, it is better to use a quantity-based approach and therefore tradable permits; when it is suspected that there will be a rapid rise in costs according to the rate of abatement, with a relatively flat damage curve, it is better to use taxation to put a ceiling on the maximum cost borne by the agents (Godard and Henry, 1998);
- *organisation and trading costs involved in the implementation of the instrument* taking into account the characteristics of the population of agents whose behaviour is to be regulated: tax is more appropriate for regulating the actions of a large number of agents, while tradable permits can be considered for situations where a smaller number of agents are involved, but there must nevertheless be enough of them to avoid the strategic bias of competition which is too imperfect⁴.
- *the possible desire of the authorities to give a fiscal dimension (production of new budgetary resources) to the instrument chosen*, which, in practice, is easier with taxation than with tradable permits, even if it is theoretically possible to auction permits.

In fact, for most of the problems, it is possible to develop an instrument based on the idea either of taxation, or of tradable permits. However, there are two important differences which will determine the choice of one option over the other. The first involves the choice of the variable to be the uncertain element. A taxation approach implies greater uncertainty on the physical performance which will be achieved given the generally imperfect knowledge of the agents' response to prices, while a permit approach guarantees greater certainty in terms of physical performance but uncertainty on price. The second difference concerns the relation between the economic agents and the administrative authorities. The particulars of the tax remain in the hands of the authorities, whose economic arbitrariness some agents are afraid of, while with permits, once the ground rules are established, the transactions between economic agents will make the market and establish the price.

⁴ One could very well imagine a system of trading involving some ten agents, like industrial facilities located in the same industrial area. A system of permits can also be implemented for several thousand agents. The institutions required for the instrument to function properly must be adapted to the case. A well-run market potentially involving a large number of agents needs a stock exchange mechanism for trading.

Depending on how much confidence is placed in the government departments and how much in economic behaviour in any given country, the balance will tip in favour of one instrument or the other.

1.2. Instruments often poorly understood

Like the polluter pays principle, the mode of action of economic instruments is often poorly understood, and sometimes even completely misunderstood. A recurrent false idea criticises the supposed immorality of using a price mechanism to deal with environment problems. Some people see it as giving unacceptable recognition to new "polluting rights", that is of rights to harm others. This is a far cry from reality. Economic instruments have no aim other than ensuring better distribution of the new obligations and limits imposed on economic agents in their use of natural resources to protect the essential properties of the environment for the inhabitants, according to goals, a strategy and schedule defined by the public bodies. Whenever the most conventional regulations do not stipulate zero emissions, they allow certain polluting emission rights. Nothing new is added by economic instruments in this respect. For example, the introduction of a system of tradable permits for carbon dioxide emissions would limit the present free access of polluters to the capacity of the atmosphere to absorb CO₂ emissions. This instrument would then help give effective protection to a collective asset, the climate of the planet, which would not be privatised for all that! As for the effect of a tax, sometimes accused of allowing rich polluters to continue polluting unimpeded, it depends respectively on the rate and the assessment base chosen, its level and the cost of pollution reduction actions. For the authorities, it is usually a case of calibrating the tax so as to obtain their target amount of emission reduction. Once polluters are subject to the appropriate level of taxation, it is difficult to see why, however rich they may be, they would rather pay a tax than reduce their pollution, when the latter option costs them less.

A second source of misunderstanding arises from confusion between economic and financial instruments. A tax designed to collect resources designed to finance general public spending or earmarked for a specific fund for redistribution in the form of various grants and subsidies does not obey the logic of an economic instrument; it just appears to do so, without having the expected effects in terms of efficiency. Economic instruments are different from all the others in two respects, information and incentives. Economic instruments act as incentives for decentralised agents to make the best use, for themselves and society, of the information they have on their possibilities of action and their costs. For example, with a tax set at a unit amount corresponding to the level of inducement desired by the authorities, polluters have an incentive to undertake all those actions for which the marginal cost is lower than the level of the tax, without detailed economic information having to be disclosed by the agents to the regulatory body. All polluters being exposed to the same economic signal, pollution abatement efforts will be spread efficiently over the decentralised agents and the total cost for society will be reduced to a minimum.

The logic of earmarked taxes is completely different and is, in fact, closer to that of the most traditional regulations: in themselves, the level of taxation and the choice of the assessment base, often a flat rate, do not give the appropriate economic signal. Economic efficiency depends firstly on the quality of the information held by the administrative authorities or the financial agency responsible for distributing grants and subsidies, and then on the form these grants and subsidies take. If grant applications contain only technical descriptions and financial estimates of the investments to be made for a specific project, they do not provide the information necessary to make the most efficient

choices among all the options⁵. If grants are only given for investment and the rate of grants is high, the procedure creates a bias in favour of excessively capital intensive solutions, without encouraging their proper management. All the limits concerning information which affect regulatory approaches likewise affect earmarked taxes.

We must therefore be clear. From the point of view of economic mechanisms and the effects obtained, taxes et tradable permits are similar, whereas earmarked taxes or taxes to be used for budget purposes are similar to regulations.

2. What are tradable permits⁶?

In a system of tradable permits, the authorities define a quantitative constraint on emissions authorised initially for each agent, but allow the agents to redeploy the permits distributed amongst themselves. The instrument therefore combines the administrative regulation defined in terms of an environmental goal and a mechanism for the transfer and re-allocation of the constraints. Thus, in a quota system, the public authority sets a ceiling for a given territory (an industrial area, a region, a country) and a given period (one year, five years...). Then it divides this ceiling among the sources, for free or by selling emission permits to firms. Firms are then free to choose the means of reducing their emissions to the quota available, but are also free to trade permits amongst themselves. This trading results in the formation of a market price, which is here the free variable of the system: the price must rise to the point at which permit supply and demand are balanced. What, then, are the properties of this instrument?

2.1. A factor of economic efficiency to meet a quantitative constraint

By being traded, tradable permits reduce the overall economic cost of emission reduction efforts. This is possible because of the process of pollution abatement marginal cost equalisation to which these agents are subject. This basic mechanism is illustrated in Figure 1.

Once the desired environmental performance is guaranteed, the main economic advantage of tradable permits is that they minimise costs. To what extent depends on the contexts of application and can range from de 10 to 95% (Tietenberg, 1992).

A number of points can also be seen from Figure 1:

- Trading is beneficial for both parties at the same time; it is not a case of winners and losers!
- The fall in costs brought about by trading does not affect observance of environmental constraints as long as the impact of the emissions is not or not significantly linked to the location of emissions.
- While the permits are allocated free of charge, the polluters nevertheless assume the financial cost of the expenditure necessary for the environment to be in a state considered acceptable by the authorities, as would be the case with a regulation. In this case, the polluters would in fact pay only this expenditure, and nothing more, unlike what would happen with an incentive

⁵ See the evaluation of the water agencies' mechanism in France by the General Commission for the Plan (1997).

⁶ For a study summarizing the implementation of tradable permits, see O. Godard (1999b).

tax: the polluter pays principle, as initially defined by the OECD in 1972, is strictly followed here both in spirit and to the letter.

- The equilibrium price p reflects both the level of constraint fixed (here a reduction of 50%) and the functions of costs of reduction specific to each agent; on the other hand, it does not depend on the initial method of distribution of the permits between the two sources (here distribution according to a homogenous rate of reduction); the latter property allows the settlement of the question of the initial allocation to be considered according to criteria giving an important place to considerations of equity without the economic efficiency of this allocation having to be the main concern, since this goal is achieved subsequently when the permits are traded.

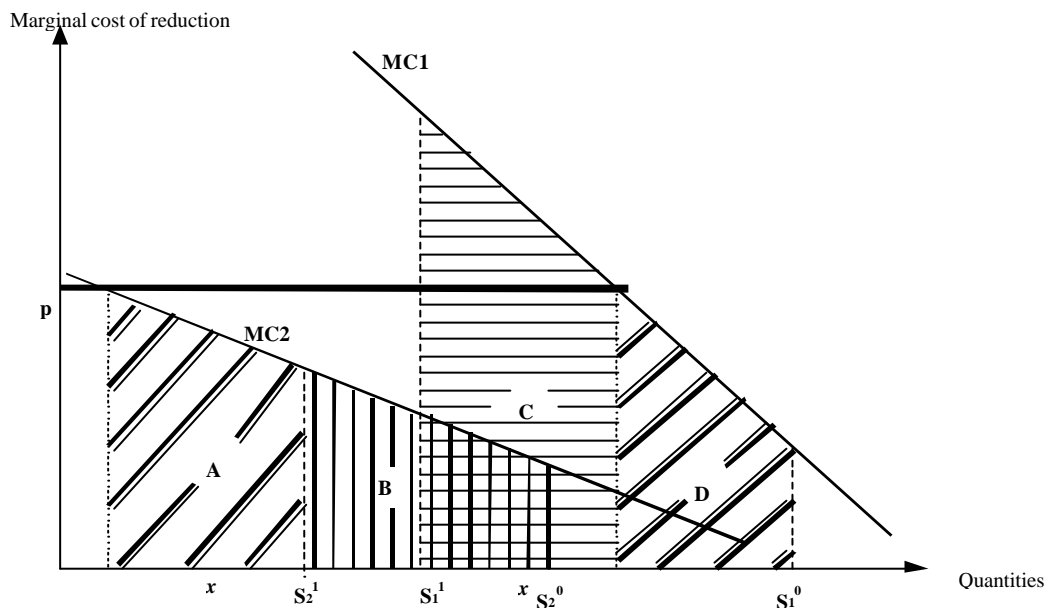


Figure 1: A 50% reduction in emissions (Godard and Henry, 1998)

This figure shows the position of two sources S_1 et S_2 , whose respective levels of emission before any reduction are S_1^0 and S_2^0 respectively. With a uniform goal of a 50% reduction in emissions, S_1 must bear a total cost represented by the area $C + D$, to reach level S_1^1 and S_2 a cost represented by the area B to reach level S_2^1 . The equilibrium achieved (S_1^1, S_2^1) corresponds to noticeably different total costs, but marginal in particular, between the two sources. For the parties concerned as well as for the community as a whole, a different allocation of effort would result in a cost saving while meeting the same overall quantitative constraint. This is what is allowed by a mechanism of permit trading between the two sources, balancing at price p . If emissions are reduced by a further x units, S_2 will have a permit surplus that it can resell to S_1 which will limit its reduction effort accordingly. In total, S_1 now bears a net cost of $D + px$ and S_2 a net cost of $B + A - px$. The total cost $B + D + C$ is brought down to $B + D + A$, with $A < C$.

2.2. The other advantages attributed to tradable permits

Interest in tradable permits generally concerns the combination offered between a cost reduction economic mechanism to reach a given goal and the choice of an entry variable of the policy which gives considerable *ex ante* certainty on the environmental performance which will be obtained. The permit approach in fact deals fairly directly with the environmental impacts of human activities, through the formulation of quantified goals or quantified physical constraints linked to environmental goals, whereas regulations focused on technology alone give only approximate guarantees on the final impacts on the milieu and taxation is exposed to uncertainty on the agents' responses to prices. Often supported by environmental protection organisations, the importance of certainty about environmental performance depends on the problem under consideration. It may be important for local threshold-dependent health problems; it is only of academic interest for long-term problems like the greenhouse effect for which evolution trajectory and accumulated stocks count for more in the solution of the environmental problem than individual performance on a given date (Godard, 1993).

The permit system also entails strict control of observance of quantified parameters (for example by continuous monitoring of emissions) unlike regulations which sometimes only use random checks or checks which are insufficient to ensure that the rules in force are properly applied. From the point of view of the political economy of the instrument, each agent holding a permit is interested in seeing that the other agents comply with the rules, since the value of the permits they each hold depends on it. They will therefore already be on the watch for this.

On the economic agents' side, tradable permits introduce a flexible element into pollution abatement policy, by avoiding holding up economic development in areas where the quality of the environment does not attain quality goals. This was the initial motivation for the first experiments in the USA around 1977 and the basis for the offset system: a new facility which will pollute can be established in an area which does not yet meet ambient air quality norms, but it must both use the best available technology and buy emission reduction credits from a facility located in the same area, which will offset its own pollution (Dwyer, 1992; Godard, 1994).

From the point of view of those in charge of environment policies, tradable quota systems, but not the credit system, have the advantage of automatically adjusting the mechanism to the general economic context (inflation, growth), without depending on administrative and political adjustment decisions sometimes difficult and often delayed, as in the case of taxes.

When permits are distributed free of charge within an envelope whose limits express the aims of the environmental programme, they do not impose an additional financial burden on firms over and above emission reduction expenditure. However, they will automatically generate a new scarcity income, which the various actors will try to appropriate. This is well known in the property sector with building rights. The prospect of benefiting from a secure income which offsets, at least partially, the additional expenditure on emission reduction, is obviously attractive for potential beneficiaries. On the other hand, a desire to divide this income widely among the economic agents can lead a government to combine tradable permits and taxation as the American government did for rights to produce CFCs under the draconian reduction goals set by the Montreal Agreement and the subsequent agreements. The prospect of a potential income transfer from the community to certain firms, or from firms to the community, is an important aspect of the problem of the initial allocation of

permits, all the more important as there would be a mismatch between the beneficiaries of the income and the agents having to bear the costs of emissions reduction⁷.

Finally, in terms of the agents taken individually, permits are a positive incentive to reduce pollution and use of resources beyond the administrative limit, since this additional effort can be made to pay by disposing of unused permits. In this sense, tradable permits, like incentive taxes, represent *a priori* an incentive for technological progress. Similarly, the instrument enables agents to take advantage of fairly rapid, unexpected changes in the institutional environment (a fall in rail transport tariffs, for example) and technological environment (purification techniques), instead of being held prisoner in a regulatory straight jacket imposing technical solutions which rapidly prove not to be the best, as shown by the experience of the Acid Rain programme in the United States.

3. Tradable permits in the United States

The United States was the first to introduce the instrument of tradable permits into its domestic atmospheric pollution management policy. It was first tried out in the late 70s in the form of occasional arrangements which were necessary, mainly in California, to find a way out of situations of potential stalemate in industrial development in areas where air quality standards had not been attained. Since then, the reform in the Clean Air Act, which came into force in November 1990 to deal with the problem of long-range acid pollution, has given an important place to this instrument, by laying the foundations for a national SO₂ emission permit market between power plants.

3.1. Initial experimentation in 1977

It was in the mid-70s that the Americans started to try out different ways of introducing economic flexibility into an administrative pollution control which was then particularly stringent, rigid and complicated. At that time, industrial activity was hedged about with a whole series of regulatory requirements: federal air quality standards (density of different pollutants in the air) and others specific to the federated states; a series of technological standards defined by type of activity and technique, with different values depending on whether the facilities were existing or new, and whether they were in attainment areas or in non-attainment areas, and, finally, ad hoc administrative authorisations for each facility.

Among the different ways tried out with varying degrees of success (Godard 1994, 2000), I shall mention two:

- bubbles: in a bubble, total emissions performances expected from existing sources within a specific area are lumped together; in the American case, the area was that of the industrial site;

⁷ In the case of the greenhouse effect policy, a country could decide to set sector tradable quotas for the consumption of fossil products. For example the petroleum refining sector would receive an annual tradable quota of tonnes of carbon which would limit the national supply of fuel, subject to international trade or inter-sector transfers of emission quotas. For the market to be balanced, fuel prices would need to be increased by the oil companies to a level where demand would once again be compatible with the rationed supply. The efforts to adapt to this new situation would be borne by the various categories of fuel users, while the scarcity income expressed by the increase in price would be appropriated by the oil companies in a way which would doubtless not seem very legitimate to the majority of citizens. Taxing oil income would bring in the resources necessary to relieve the regressive impacts on consumers' income.

this method allows emission capacities to be redistributed between the different sources present in the area, as long as the total ceiling is not exceeded;

- offsets: this method was designed for new facilities which were seeking to locate in a non-attainment area. To be authorised, these facilities had to both use the best available technology and ensure that the emissions of facilities located in the area were reduced by an amount considered equivalent to the extra emissions that they were going to make, on the basis of an offset rate defined for the zone and the pollutant in question. For example, to locate in an area where air quality was considerably below the norms, the rate applicable could be 1.5. To be entitled to emit one tonne of pollutant, a new facility would have to have acquired emission permits for one and a half tonnes from existing facilities.

It is generally agreed that these methods gave mixed results, although the gains are assessed at several billion dollars over some ten years. There are many reasons for this: lengthy prior authorisation administrative process for each proposed transaction, costs of looking for an outside partner and frequent changes to the rules by the government arousing mistrust by firms afraid of falling into a trap. Offering to sell emission permits reveals that the firm can pollute less and run the risk of triggering a subsequent tightening up in the standards; buying permits shows that the firm does not want to reduce its pollution and reveals that it is not a good citizen...

The experience did, however, prove sufficiently positive for the Americans to give tradable permits a new lease of life in the Clean Air Act reform introduced in November 1990. In it they did their utmost to remove the obstacles and avoid the errors made.

3.2. The 1990 Clean Air Act reform

This reform created an entirely new tradable permits programme, the Acid Rain Program, for the whole of the country, concerning SO₂ emissions by power plants (Ellerman et al, 1997; Harrison, 1999; Godard, 1994, 2000). Its aim: to reduce acid rain which impairs water quality (the Great Lakes) and threatens forests. This problem is a diffuse, long-range pollution problem and not local pollution. The electricity sector, responsible for 70% of emissions, will have a permanent sector ceiling of 8.95mt as of 2010, which comes down to asking power plants for an overall reduction of 50% compared to 1980 emissions. To the extent that it aims only at long-range pollution, trading can be carried out over the whole country on the basis of a single exchange rate of 1 for 1, without restriction. Nevertheless, all the measures on the quality of the local environment, in particular for the protection of public health, remain fully in place, the Acid Rain programme only being added to them. Individual quotas were allocated for free to each power plant on the on the basis of its average heat consumption in the period 1985-1987. Additional permits were distributed for the first period 1995-1999 in order to do justice to the various political demands affecting certain regions (Florida, Middle West).

The programme became compulsory on 1 January 1995 and was divided up into two phases: 1995-1999 and 2000 onwards. Virtually all the power plants are subject to the system since the start of the second phase, which has seen the total amount of allocations halved. From 1996, any new plant has had to buy all the SO₂ permits it needs, while plants in existence before this date will continue to receive their annual free allowance until 2025. Permits not used one year can be used in a subsequent year (banking).

Trading can be carried out freely. No prior authorisation is required. It can be conducted with any possible partners (brokers, merchant banks, other companies, NGOs, individuals). Futures trading is possible, for example, selling a permit in 2000 which will be valid only in 2005. The Environment Protection Agency (EPA) must be notified of trades, and has set up a system for the electronic registration of the initial allowances of all the plants and trading. This accounting system only records the quantities held and traded and contains no information on prices. A heavy penalty is stipulated for emissions above the permits held: \$2,500 a tonne in 1996, or ten times the top of the price range on the market during the first years.

In order to help establish the market, every year, the EPA retains a quota of 2.8% of the total quota distributed, to put them up for auction. The Chicago Board of Trade has been given the task of holding an auction, at the end of March every year. The income from the sales of this reserved quota is returned to the power utilities.

Once trading started, observers were in for a surprise: trading prices were at a level much lower than the estimates previously put forward by different parties (up to \$1,000 and more a tonne). The first private trades were struck at around \$250. The EPA's first annual auctions were held in 1993 with an average price of \$170. After that, it plummeted to around \$70 in 1996, went back up in 1997 to around \$100, then doubled reaching the \$200 mark early in 1999 and ranged from \$200 to \$150 as the second, much more restrictive phase approached. The volume of trading between distinct agents remained low from 1992 to 1995, but increased strongly as from 1996. From 11% of the total in 1995, it rose to 70% in 1998.

In the area of costs, a favourable but overly superficial interpretation could present this experiment as a considerable economic success, on the basis of the enormous difference between the market prices of permits and the cost estimates put forward and by attributing all the cost savings partly due to largely external reasons to the effectiveness of the instrument, like, for example, the fall in rail transport tariffs for coal from the West Coast of the United States. In fact, the trading possibilities have allowed substantial cost savings, even if they are not so huge. The freedom of choice in solutions given to operators has increased competition between the different types of solution, has challenged captive markets and promoted innovation, especially among desulphurisation equipment manufacturers. It has also enabled power utilities to seize external opportunities like falls in the price of low-sulphur content coal. According to US Government Accounting Office official estimates, internal trading within companies alone should result in savings of 42% in 2001 on reduction costs which would have been imposed by a conventional regulatory approach subjecting all plants to homogenous standards. With a fully developed market, total costs of the SO₂ emissions reduction policy could be three times smaller. A detailed retrospective evaluation carried out in 1997 by the MIT puts these gains for 1995, the first year of compulsory application, at around 30% of the costs of a scheme without the possibility of trading (Ellerman et al., 1997). This can be considered a floor price.

The American experience has taught us a lot, both by the limits discovered during the period of experimentation 1977-1989 and the SO₂ market successfully launched since the 1990 reform of the Clean Air Act. Even for the latter programme, things did not go by themselves and there are still initiatives like that, in April 2000, of the State of New-York aimed at discouraging trading between the companies in the State with those in the States of the Middle West and the South by imposing, in the name of local environmental protection, public collection of the income from trading done with the latter. This is one of the important fault lines for this instrument, as will be shown below by the

approach to the same problem of long-range acid pollution in Europe. It is therefore necessary to look further at the obstacles to the implementation of tradable permits.

4. Obstacles to using tradable permits

There are not yet many examples of the implementation of tradable permits, particularly if one has in mind the fuller development of this instrument in the form of an organised market. This cannot be put down to a total absence of projects along these lines. In a number of countries, projects have been taken quite a long way (Norway, Switzerland, the United Kingdom). In others, local experiments of limited scope in terms of the number of participants have been carried out (Poland). In some cases, the systems proposed have had their institutional and legal beginnings, but resulting in virtually no trading (Switzerland). Analysis of these contrasting experiences (OECD, 1999; Sorrell, 1999) shows certain obstacles or unfavourable circumstances:

- *the lack of interest by the main participants in the political process for seeking collective economic efficiency*, even if the position is changing in this area; in fact, the quest for economic efficiency is one of the principal motivations supporting this instrument;
- *the organisation of administrative systems based on inclusion in the published regulations of engineering approaches, with the concepts of Command and Control and Best Available Technology - BAT*. Any approach which is rigid in terms of BAT, in practice leaves decentralised agents with very little margin for flexibility in the choice of means and in particular that of trading permits, except for the offset systems imposed on new facilities where the obligation to use the best available technology is combined with that of covering all emissions by the acquisition of permits;
- *low compatibility with the existing regulatory systems, in the case of attempts to graft tradable permits on to the schemes in place*. The approach of emission credits determined from individual regulatory requirements, without reference to an overall ceiling, has given mixed results in the United States. In particular, this approach entails cumbersome administrative requirements for defining the rights to tradable credits (ad hoc administrative examination of each case to determine the credits, prior authorisation application before any trade), which has hampered many transactions. Moreover, regulatory approaches which define emission limits in relative terms (maximum emissions per hour or per day; concentration of pollutants in releases) do not encourage the use of quota systems, which involve the definition of absolute quantitative limits (tonnes of SO₂ or CO₂ released annually, for example).
- *tax income losses resulting from the replacement of existing tax instruments by tradable permits distributed for free*; most of the existing tax systems grouped under the term ecotaxation have a marked budgetary aim; the changeover to a system of free permits is seen under different lights, as a loss of budget revenue by the tax authorities and as the main advantage to be gained by firms through a system of tradable permits;
- *the inability of the players to solve the problem of initial allocation satisfactorily for the main interest groups*; from a political point of view, the initial allocation is a headache. Involving, as it does, dividing up effort, but also a secure income, it is a point when conflicts will mushroom between sectors, between industrial groups, between major companies and SMEs etc.; these political difficulties may lead the authorities to give up this instrument (Sorrell, 1999);

- *the active desire of the members of the administration to keep the positions of power and the status* given to them by the traditional system of pollution control. It generally allows them great discretionary power of assessment, quite at odds with the normal functioning of tradable permits which, once clear, specific and stable rules have been defined, needs automatic procedures and the absence of administrative interference;
- *the belief held by the public authorities, and also company bosses, that the flexibility desired by the latter will be obtained as cheaply, while not having to launch large-scale institutional changes, by the informal negotiation of the conditions of application of the regulation, rather than by a formal system of tradable permits.* Tradable permits are instruments giving flexibility, but this flexibility has a formal legal base and must be overseen by strict supervision of the rule application. This is an approach which does well when, for various reasons, the previous administrative system has to submit to stricter observance of the rules and therefore loses the flexibility it could make use of informally. While the interested parties still think they can solve their problems informally by using leeway in the application or non-application of the rules and standards, there is virtually no place for tradable permits;
- *the cultural aspect resulting in Europe in a reluctance to associate environmental protection with the market.* Referring to "pollution rights markets" as is the case on the other side of the Atlantic could be considered in many countries as a serious error in communication, hindering the spread of the instrument, in addition to the fact that it does not really correspond to the solutions used and the change introduced. Tradable permits introduce limits and obligations where there was previously, in fact, an unrestricted "right to pollute". This cultural reluctance can, nevertheless, lead firms not to take advantage of the trading opportunities which would minimise their direct costs but could compromise the image they want to promote among the population;
- *insufficient pressure from environmental constraints*, as was the case in the United Kingdom for acid pollution abatement because of the large-scale introduction of gas in power generation, to replace coal (Sorrell, 1994);
- *the absence of interest groups to promote the instrument.* Even if an instrument has attractive theoretical properties, this is not enough to ensure that it will be adopted by the political process. It also needs to be supported by an influential coalition of players. Until very few years ago, no coalition of this sort had appeared in the countries of Europe.

To overcome these obstacles, the authorities would do well to include tradable permits in a rationale for solving the problems which are a concern to the influential players in the regulation system (government, firms, professional organisations and trade unions, environmental conservation and consumer organisations and local communities). These actors need to be convinced that it will be difficult for them to solve these problems under the regulatory system in place and also that tradable permits can provide a better way of solving them than other economic instruments. The problems to be taken into account for this are not environmental problems directly, but those which make sense for the different categories of players. For example, firms, are primarily interested in protecting themselves against administrative arbitrariness and improve for their benefit the implicit distribution of ownership rights over the environment or at least avoid a negative transfer. NGOs often want to obtain guarantees on environmental performances by imposing constraining regulations and to be regularly associated with political management in the field of public action ...

5. The problem of integration into the existing institutional context

If the rationale of economic instruments is to be effectively deployed agents must not be confined in a system of technical constraints and requirements which do not leave them any choices. It must therefore be ensured that the constraints imposed under the goals of the environmental policy do not go beyond what is really necessary and leave agents as much leeway as possible in the means chosen. Naturally, this area of decentralised choice must be appropriately polarised by economic signals reflecting collective priorities and scarcity, without which, decentralised decisions would lead to choices which are not good for the community. The aim of economic instruments is to provide the "right" signals.

The first of these two conditions is generally fairly poorly fulfilled by the institutional mechanisms for implementing environmental policies. The first question is therefore whether it is possible to introduce tradable permits into the existing mechanisms without ruining the prospects for economic efficiency which are the reason for their introduction. Compromises may, however, be necessary in a progressive approach to reform, with the result that there are four possible options:

- (a) give up the use of tradable permits completely;
- (b) graft certain forms of tradable permits on to the margins left by the regulatory mechanisms in place, on the basis of the main existing parameters; this generally corresponds to the emission credit approach. In this way, some cost savings and additional operational flexibility can be achieved, without being able to expect full efficiency;
- (c) introduce alongside the existing mechanisms, an entirely new system of tradable permits, with all its rules designed to optimise their performance;
- (d) carry out an in-depth reform of the existing regulatory system in order to be able to easily develop economic approaches. How attractive these different options are depends on the type of environmental problem to be dealt with. Is it a new problem for which there is not yet any mechanism for public action or a problem already covered by a regulatory system? The more a field of public action is already institutionally covered, with extensive legislation, an administrative organisation developed at a number of levels over the country with the involvement of a number of departments or agencies, the greater the difficulty in introducing a new system with a different spirit. It remains possible, however, to try to reorient the margins of the existing system to improve its efficiency.

To sum up, it is possible to have two types of aim for tradable permits: either improving the existing system by introducing elements of flexibility into a system which remains essentially regulatory in inspiration; or set up a new mechanism designed to promote full development of the economic instrument. The different options are summarised in Table 1, illustrated by examples, some of which are real and others made up.

The difficulties encountered by grafting tradable permits on to existing rules and mechanisms are perfectly illustrated by the study of the possible ways of inserting this type of instrument into the European long-range atmospheric acid pollution abatement system.

Table 1. Tradable permit integration options

Institutional framework \ Problem	Already covered	New
Extension of the existing framework and/or addition of flexibility on the margins	<i>Examples:</i> bubbles on atmospheric pollution for an industrial complex; ‘evening out’ of energy consumption requirements over a range of vehicles	<i>Example:</i> extension of the application of BAT and the European IPPC Directive on the regulation of greenhouse gas emissions, leaving, however, little room for the deployment of tradable permits
New separate tradable permit program, with the general pre-existing framework maintained	<i>Example:</i> Acid Rain programme in the United States, added to local SO ₂ pollution regulations	<i>Example:</i> setting up of a separate programme of tradable carbon emission quotas, not coming under the European IPPC Directive
General regulatory reform to adapt the institutional framework to the spirit of economic instruments	<i>Example:</i> replacement of a standard regulatory control policy by the RECLAIM tradable permit programme in the district of Los Angeles	<i>Example:</i> general tradable permit development policy in the different fields of environmental protection, like that chosen by the EPA in the United States

6. Three possible ways to organise SO₂ emission tradable permits within the European Union

The Oslo Agreement divided quantified SO₂ emission reduction goals with different deadlines between each signatory and recorded at the same time a long-term goal of adhering to critical acid deposit loads for each basic zone in European territory, with a size of 150km by 150km. The goals decided on aim at a 60% reduction in deposits in excess of the critical loads for each zone (Klaassen, 1996). There are two basic constraints here which complicate the design of a tradable permit system to be inserted in the existing framework, since it is necessary to find a system combining emission constraints and deposit constraints. A system of emission permits resulting only from the implementation of national goals has no reason to allocate reduction quotas between plants to ensure the observance of deposit constraints; a system based on deposits alone might not be compatible with the distribution of emission quotas between countries. Three different ways can be suggested to deal simultaneously with the two constraints in question (Cros and Godard, 1998; Godard, 1999a):

- with the first, the two constraints are integrated into the same system, with a distinction introduced between usable permits and tradable permits; authorised trades are the result of the differences in allocation corresponding to each of the constraints;
- the second has two types of permit, the authorisation to emit being suspended at the meeting, in the same quantities, of two types of permit which each represent one of the constraints (emission and deposit);
- the third establishes a market between emitting facilities on the basis of deposit permits and leaves governments to organise between them offsets for the variations in emission quotas in comparison with their country’s commitments.

Insofar as the two constraints are not immediately expressed in the same unit, it is necessary to model pollutant transport to give the distribution of the deposit location according to emissions, and it is likewise necessary to have a zone-based ecological sensitivity map. By the combined use of these instruments, the difference can be calculated between deposits and critical loads, as well as the corresponding information, in terms of emissions, of the goal of a 60% reduction in excess deposits. The quantity of expert information needed for the system to function is therefore considerable, and the options presented risk, in practice, being highly complicated in operation. However, this complication is not an intrinsic feature of tradable permits but of the framework of constraints resulting from the existing regulatory system, designed in the spirit of centralised action planning.

If, one day, all the countries of the Union handed over their national quotas to a sovereign European agency, then one type of permit only and a single type of market, based on deposits and the goals for critical loads, could be enough. However, this assumption does not fit in with the present political conditions prevailing throughout the Union, which is not a federal state. If it is to avoid being unrealistic, the design of any tradable permit scheme cannot afford to ignore this institutional and political constraint. This is what the three systems proposed aim to take into account.

The alternative would be to adopt a solution similar to that of the American Acid Rain programme, which has the major advantage of being simple. There is one undifferentiated market for the whole territory and any fears over problems of a local concentration of pollution will be dealt with by regulatory measures for the protection of the local environment to which the tradable permit system is added and by the severity of the overall reduction target imposed. With an overall emission reduction of 50%, it is fairly unlikely that there will be an increase in deposits in many places!

However, let us explore how the three solutions outlined might function in the context of the present European system.

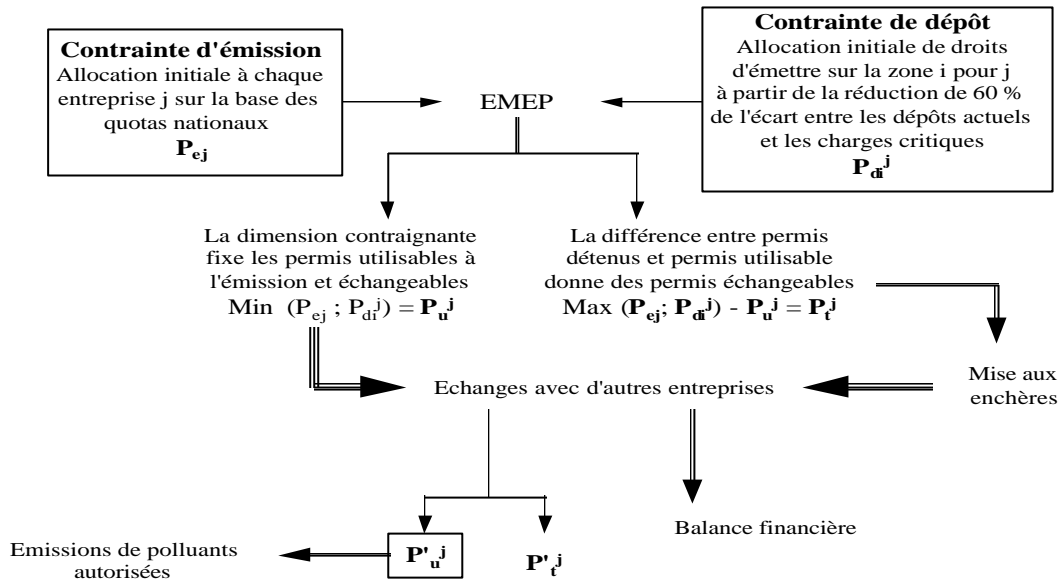
6.1. An integrated system distinguishing emission rights and trading rights

The guiding principle of this system is the distinction between emission rights and permit trading rights. Holders might have in their assets a total quantity of permits, only a part of which would be directly usable by them to cover their own emissions, while also being tradable, whereas the other part could not be used directly, but could, nevertheless be disposed of to other holders, who, under certain conditions, could use them. Thus, the two basic constraints of the system could be taken into account.

The allocation procedure could work as follows: an initial allocation of source permits would be calculated on the basis of national emission quotas. The geographical impact of this allocation would then be assessed using physical modelling. The localised results obtained would be compared to the maximum deposits acceptable on each zone in accordance with the rule of a 60% decrease in excesses over critical loads. The lower of the two values would be the *strict* allocation of permits which would be both usable and tradable by their holders. The other value would then correspond to the so-called *broad* allocation. The difference between *broad* and *strict* allocations would give rise to "tradable but not usable permits". These permits could for example be used to build up a national reserve of permits destined to be auctioned by the central authority. That would give references for bilateral trading. Buyers of these permits would still be subject to the same basic requirements in terms of deposit constraints. Buying them would only be advantageous if their own deposit

constraints were not saturated. The financial income from auctions would be paid back to the holders of the rights over the permits.

A system distinguishing between emission rights and trading rights
Un système distinguant droit à l'émission et droit à l'échange



Légende du schéma précédent (Note de la traductrice : attention de bien conserver les formules initiales avec les bons symboles mathématiques)

Emission constraint	EMEP	Deposit constraint
Initial allocation to each firm j on the basis of national quotas P_{ej}		Initial allocation of rights to emit on zone i for j from the 60% reduction of the difference between present deposits and critical loads
		P_{di}^j

The constraining aspect sets the permits that are usable for emission and tradable Min(P_{ej} P_{di}^j) = P_{uj}	The difference between permits held and permits usable gives tradable permits Max (P_{ej} P_{di}^j) – P_{uj} = P_{tj}
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Trading with other firms

Auction

Authorized emissions of pollutants

Financial balance

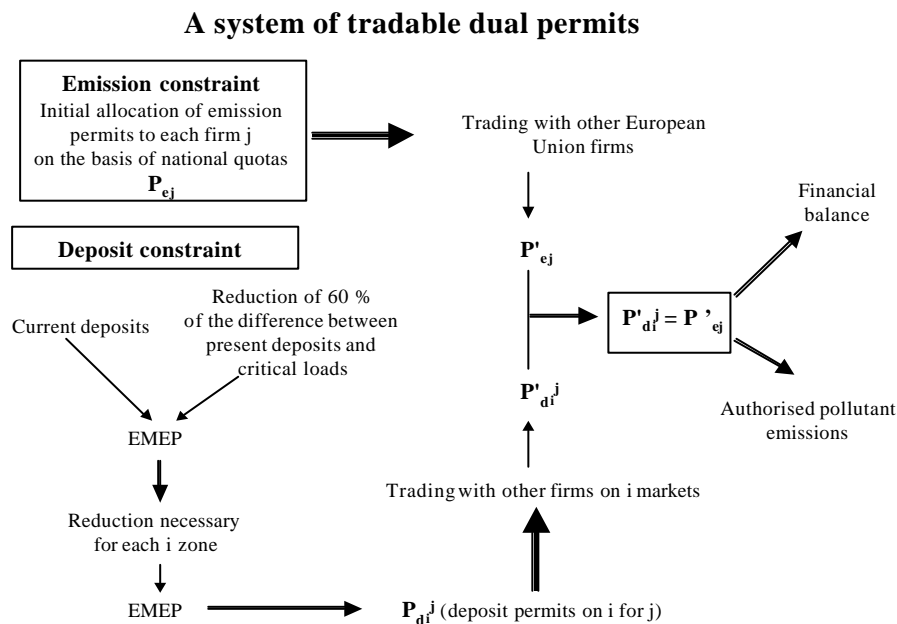
* EMEP is the name of the physical modelling system used by the Secretariat for the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe, which is in charge of its management.

Insofar as there are areas in which emission constraints are stricter than deposit constraints and others where it is the opposite, it seems logical to consider that trading could take place for "non-usable but tradable" permits by a given source.

The main limit of this system lies in the disclosure requirements for each trade, since the deposit contents of the emission permits must be tracked; emission permits must in fact be defined as a vector of quantities distributed by deposit areas. Consequently, when an agent buys x emission permits, it is possible that they will only be authorised to use $(x-n)$ of them because their deposit constraint is saturated and, in the permits purchased, there are no permits for additional deposits valid for the areas impacted by their own emissions.

6.2. A system of tradable dual permits

The basic principle of this system is to introduce two different types of permit, each corresponding to one of the two constraints of emission and deposit. Emission permits and deposit permits therefore exist side by side. To be entitled to emit one tonne of SO_2 , a source must hold a permit of each type for one tonne of SO_2 . The sources are free to redeploy their assets by trading in the two types of permit. Thus, two types of market appear, one of which, the emissions market, is Union wide, while the other only involves sources responsible for deposits in the same reception zone. If there are n deposit zones, there are potentially $n+1$ different markets.



Although it might seem complicated, practical operation of this dual permit system could nevertheless be viable, although with more limited scope than the previous system. On the deposit permits markets, there is a limited number of potential partners. The costs of identifying partners will be limited and all the potential partners already know each other. This situation has a downside: the possibility of strategic behaviour by potential partners. To deal with this risk, the designers of the system might use larger sized cells than those in the current EMEP grid (150km X 150km) for zoning: with larger unit zones, the strategic risk or the risk of blocking is reduced leaving the way free

for a more fluid market. On the other hand, by dividing Europe into 4 or 5 homogenous zones, there is greater risk of seeing certain local situations deteriorate or not improve at the same pace as the others. Compromises like this may be justified by the cost savings obtained.

It can be assumed that the agents determine their basic strategies on the deposit permits markets and then adjust their assets on the much more flexible emission permits market. Nevertheless, even though the constraint on deposits may be more stringent overall than the constraint on emissions, it cannot be assumed that this would be the case for each source, in particular in the countries of southern Europe. Whole countries like Spain, Portugal or almost all of Greece do not exceed critical thresholds in terms of acid pollution. Yet these countries have emission caps for a time scale beyond 2000. The dual system principle is therefore justified.

Combining two distinct types of permit must be seen as an incentive for trading. If the participants do not have the two permits required, a permit's use value is cancelled, which represents a strong incentive to enter a market to make use of the unused permits, be they for deposit or emission.

6.3. A system combining trading of deposit permits between decentralised agents, and an offset mechanism between governments

The dual nature of the above systems has its origins in the political balance crystallized in the Oslo Agreement. Since the countries have agreed on national rates of emission reduction, the subject of fierce negotiation in some cases, they are certainly not ready to put them back in a common kitty. A redistribution of emissions resulting from trading in deposit permits which would reduce the quotas initially allocated to certain countries with no compensation, could be challenged by the latter.

The idea underlying this third system is to keep the possibilities of trading deposit permits at only one level of organisation, that of relations between agents (power plants), while a system of financial compensation would be put in place between governments whose emission quotas would vary according to the goals set in the Agreement.

The permit allocation process could include the following stages:

- identification of the spatial distribution of the deposits resulting from the emissions of each source,
- allocation of a number of permits corresponding to present emissions, if the zone is not saturated, and less the reduction of 60% of the excesses over the critical loads in proportion to the respective contribution of each source, if the zone has a surplus of acid deposits,
- if a source S produces deposits on both saturated and non-saturated zones, its allocation will be affected. Consider the following example: let us assume that 3 tonnes are deposited on non-saturated zone Z_1 and 8 on saturated Z_2 ; the source will firstly receive 3 P_{d1} ; if over the whole of Z_2 , 20 tonnes of pollutants are recorded as excess, and source S is responsible for 5% of the zone's total deposits, then S will also receive for zone Z_2 :

$$\{8 - [(20 \times 60\%) \times 5\%]\} = 7.4 P_{d2}.$$

- The amount of total residual emissions E_R resulting from this method of calculation is the following:
 - if $E_R \leq E_T$ (total emissions authorised in Europe by the Oslo Agreement), the potential allocation of quotas is confirmed;
 - if $E_R > E_T$, the permit allocations of all the sources are reduced in proportion to the overrun.

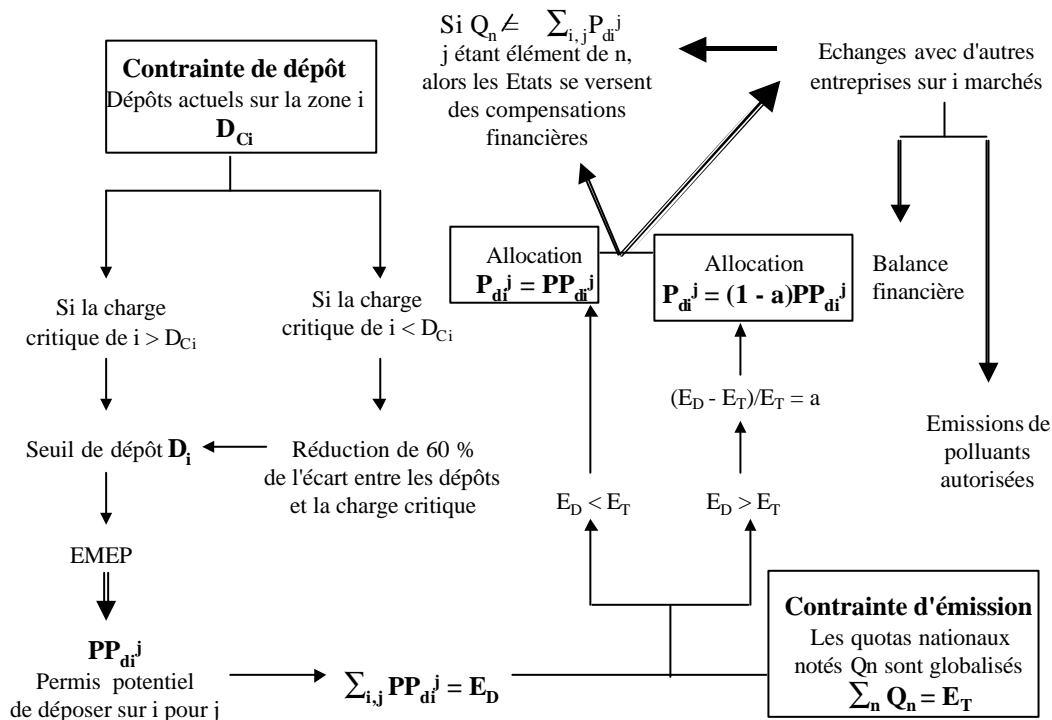
For example, if $E_R = 1,2 \times E_T$, then the initial allocation of S will be $[(3/1,2 P_{d1}; 7,4/1,2 P_{d2})]$, that is $(2,5 P_{d1}; 6,15 P_{d2})$.

An allocation of this type observes both the amount of maximum emissions authorised for the whole of the European Union and the 60% reduction of excess deposits over critical loads. However, there is no reason for it to observe the distribution between countries established by the Oslo Agreement. So that the "losing" countries do not oppose the system, a financial offset mechanism should be adopted. The necessary resources could be taken from the collective gains from the use of the new trading system. Disadvantaged countries would thus receive part of the collective income to offset their individual diseconomies. The introduction of this sort of financial compensation mechanism would not be a major upheaval in the functioning of the Union. This compensation could be determined from the market price for permits.

Légende du schéma précédent (Note de la traductrice : attention de bien conserver les formules initiales avec les bons symboles mathématiques)

A deposit-based system of trading

Un système d'échanges centré sur les dépôts



<p>Deposit constraint Current deposits on zone i D_{Ci}</p>	<p>If $Q_n \dots\dots\dots$ j being an element of n, then the States pay each other financial compensation</p>	<p>Trading with other firms on i markets</p>
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If the critical load of $i > D_{ci}$	If the critical load of $i < D_{ci}$	Allocation $P_{dij} = PP_{dij}$	Allocation $P_{dij} = (1-a)PP_{dij}$	Financial balance
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Di deposit threshold	60% reduction in the difference between deposits and the critical load	Authorised pollutant emissions
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Potential permit to deposit on i for j		Emission constraint The national quotas noted Q_n are lumped together
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The three solutions given show that it is possible to design, on paper, tradable permit systems which fall in with the main constraints resulting from the existing rules. They also show how complicated this adjustment is and suggest that it could be beneficial to challenge such rules to achieve systems which are simpler in design and therefore more operational.

Conclusion

In the whole series of economic instruments, tradable permits are a particularly attractive instrument whenever environment policies must be linked to quantitative constraints to be strictly observed on a territorial scale and have a significant economic aspect because of the costs involved. They also represent a form of public action which is well suited to the model currently emerging in Europe which seeks an explicit connection between general interest or public service goals and competitive market mechanisms (Henry, 1997). There are, of course, still obstacles in their way, but the most serious are not where the main players in pollution control would look for them spontaneously. On the other hand, two mistaken ideas are an insidious threat to the development possibilities for this instrument. The first is that it would be possible to achieve the same flexibility and the same efficiency at less cost by using instruments with a less complicated organisation, like voluntary agreements, or by discretionary modulation of the application of administrative pollution control systems. The second is that it would be possible to benefit from all the economic potential of tradable permits simply by adding them on to the existing regulatory measures and only making minor adjustments. Full development of this type of instrument, like incentive taxes, requires a change in rationale and a fairly deep revision of the existing regulatory and administrative infrastructure. Such changes should be seized upon as opportunities to move forward in environmental policies.

References

Commissariat général du Plan (1997), *Évaluation du dispositif des agences de l'eau*. Paris, La Documentation française.

- Commission des Communautés européennes (2000), *Livre vert sur l'établissement dans l'Union Européenne d'un système d'échange de droits d'émission des gaz à effet de serre*. Bruxelles, 8 mars, COM(00)87.
- Cros, C. and Godard, O. (1998), «The economic design of a potential tradable permit system for SO₂ emissions in the European Union», *European Economy – Reports and studies series* (1), European Commission, Directorate General for Economic and Financial affairs, pp. 91-127.
- Dwyer, J.P. (1992), «Chapitre 3. La politique de la Californie en matière de tradable permits d'émission et ses applications dans le cadre de la lutte contre les gaz à effet de serre: étude de cas », in OCDE, *Le changement climatique: concevoir un système de tradable permits*. Paris, Éd. de l'OCDE, pp. 41-80.
- Ellerman, D., Schmalensee, R., Joskow, P., Montero, J.P., Bailey, E.M. (1997), *Emissions trading under the U.S. Acid Rain Program. Evaluation of compliance costs and allowance market performance*. Cambridge, Center for Energy and Environmental Policy Research, MIT, October, 77 p.
- Godard, O. (1993), «Chapitre 2: Les taxes », in OCDE, *Les instruments économiques internationaux et le changement climatique*, Paris, Ed. de l'OCDE, pp. 45-107.
- Godard, O. (1994), *L'expérience américaine des tradable permits dans le domaine de la pollution atmosphérique*, Paris, CIRED, Rapport pour le Programme "Prospective et Veille Scientifique" du Ministère de l'Environnement, décembre.
- Godard, O. (1999a), « Chapter 15. Economic instruments and institutional constraints: possible schemes for SO₂ emissions trading in the EU », in S. Sorrell and J. Skea (eds), *Pollution for sale. emissions trading and joint implementation*. Cheltenham, Edward Elgar, pp. 272-295.
- Godard, O. (1999b), *La conception et l'application des permits transférables nationaux dans les politiques d'environnement. Rapport pour le Groupe de travail sur l'intégration des politiques économiques et de l'environnement*, Paris, 24-25 novembre, OCDE, ENV/EPOC/GEEI(99)12.
- Godard, O. (2000), «L'expérience américaine des tradable permits pour lutter contre la pollution atmosphérique », *Économie internationale, la revue du Cepii*, juillet.
- Godard, O. et Henry, C. (1998), « Les instruments des politiques internationales de l'environnement: la prévention du risque climatique et les mécanismes de tradable permits », in Conseil d'Analyse Économique auprès du Premier Ministre.- *Fiscalité de l'environnement*. Paris, la Documentation française, Coll. des rapports du CAE, juillet, pp. 83-174.
- Harrison, D. (1999), «Tradable permits for air pollution control: the United States experience », in OECD (1999), *Implementing Domestic Tradable Permits for Environmental Protection*. Paris, OECD Publications, pp. 23-51.
- Henry, C. (1997), *Concurrence et services publics dans l'Union européenne*. Paris, PUF.
- Klaassen, G. (1996), *Acid rain and Environmental Degradation. The Economics of Emissions Trading*. Cheltenham, Edward Elgar.
- OCDE (1994), *Gérer l'environnement. Le rôle des instruments économiques*. Paris, Ed de l'OCDE.

OECD (1999), *Implementing Domestic Tradable Permits for Environmental Protection*. Paris, OECD Publ.

Sorrell, S. (1999), « Why sulphur trading failed in the UK », in S. Sorrell and J. Skea (eds), *Pollution for sale. Emissions trading and joint implementation*. Cheltenham, Edward Elgar, pp. 170-207.

Tietenberg, T.H. (1992), *Environmental and Natural Resource Economics*, New-York, Harper Collins Publ.