THE POLLUTION POLICY "COCKTAIL" IN ESTONIA: ECONOMIC INCENTIVES AND PROBLEMS FOR IMPLEMENTATION

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Economic Incentives and Problems for Implementation

I. Introduction

Estonia continues to make the transition from a centrally-planned unit of the former Soviet Union to a market-oriented and open-market component of the world economy. Industrial and agricultural output have fallen, energy use has fallen and energy prices have risen, and trade has been diversified away from the former Soviet states and towards the west.[1]

This transformation has had a profound impact on point and nonpoint sources of water, air and solid waste pollution. Due to realignment to world market prices in agriculture, the livestock herd, cultivated area, and mineral fertilizer use have declined, which has reduced point and non-point sources of water pollution from the agricultural sector. The reduction in electricity use and production has substantially reduced emissions from the country's two main power plants, Baltic and Estonian, which are also two of the biggest polluters in the country. For these two power plants, sulfur dioxide emissions have fallen from about 180,000 tons in the early 1990s to about 97,000 tons in 1993, while nitrogen oxides have fallen to about 4,000 tons in 1993. Water consumption and effluent discharges from industry and agriculture have fallen as well, while household water consumption and waster water discharges have remained relatively unchanged (Estonian Environment, 1993).

While the transformation to a market economy has yielded some important environmental benefits, a revised system of environmental policy continues to be developed and implemented as one component of the overall transition to a modern market economy.[2] For example, during 1993 alone, over 85 formal policy statements

[1]For example, industrial output has fallen about 40 percent since 1989 (Ministry of Economic Affairs, 1994, page 20), while agricultural output fell 21 percent in 1992, 17 percent in 1993, and is expected to fall another 12 percent in 1994. Electrical energy production fell from 17.6 TWh in 1991 to 9.1 TWh in 1993, although a slight increase is predicted for 1994, and electricity consumption fell from 7.0 TWh in 1991 to 4.9 TWh in 1993, with a slight increase predicted for 1994. Mining of oil shale, the main fuel source for electricity generation, fell from 23.3 million tons in 1991 to 14.9 million tons in 1993, with a slight increase also predicted for 1994. Consumption of other energy sources, such as peat, heavy fuel oil, and natural gas also fell substantially during the 1991-93 period. Trade has been reoriented towards new markets, with the share of total trader to the former Republics of the Soviet Union falling from about 95 percent in 1991 to about 26 percent in 1993. As of 1993, about 30 percent of exports went to the Common Wealth of Independent States, 31.5 percent to EFTA, and about 18 percent to the European Union. The rate of privatization has varied across sectors, with most services and retail businesses in private control and major industries including energy production and supply remaining under state control. As a result, over 63 percent of industrial production was produced by state and municipal enterprises (vast majority of this state produced).

[2] Given the historic lack of effective environmental policy in the former Soviet Union, it is perhaps important to define explicitly what the word "policy" means in market economies. According to a standard dictionary definition, ***policy*** is "a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions", where these decisions are

targeted directly at environmental issues were passed by Estonia, including laws, regulations and rulings of the government, and regulations and decrees of the Ministry of Environment. Several other laws and regulations, such as income and valued-added tax laws were also passed that more directly influence economic activity as, as a result, the use of natural resources and the generation of pollution. The goal of developing such policies now is to create the conditions so that environmental concerns can be correctly internalized into the decision making process of both new private enterprises, public-owned state and municipal enterprises undergoing privatization, and remaining public-owned enterprises.

Major changes to Estonian pollution control policy took place in December of 1993 and early 1994, when the basic framework law and several regulations were revised and adopted. This system is perhaps best described as a mixed system, or perhaps better a policy "cocktail", based on a combination of pollution permits, threshold levels, differential charge rates, self-reporting, state inspection, some ambient and emission standards, certain types of fines for not having permits and not paying charges on time, and potential court action.[3] Given the short time since several policy changes took place, there has been no systematic analysis conducted and reported of the workings of this system. Such policy analysis is needed to know if the current system, as written in laws and regulations and implemented and enforced on the ground, is achieving its intended goal.

The purpose of this chapter is to fill this policy analysis gap.[4] We proceed as follows. Section II develops a basic and simple economic model of pollution control to provide a reference point from which to view Estonian policy. While the model itself is simple, several key assumption/implications of the model are identified that are important for the Estonian case. Section III then turns to the details of Estonian policy as written in law, further specified in governmental and ministerial regulations, and as currently practiced. Based on this analysis and discussion, several key issues/problems are identified that must be clarified and solved by the government (Ministry of Environment, the County Environment Departments, Inspectors, etc.) and the regulated enterprises to improve effectiveness of the current policy system in Estonia.

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made by government agencies, public and private sector enterprises, and households (Webster's Seventh New Collegiate Dictionary, G.&C. Merriam Company, Publishers, Springfield, MA, USA, 165, p. 656.

[3] The word cocktail was inspired by Opschoor (1993).

[4] Economists usually think of ***policy analysis*** in two ways. First, when choosing new policy, it is important to analyze the impacts of the different alternatives, in terms of economic costs and benefits to different members of society, to guide the selection of the alternative. And a second type of analysis, conducted in this paper, analyzes how existing policy is working, whether it is achieving its intended impacts to "guide and determine present and future decisions", and whether anything can and should be done to improve on the workings of the policy.

II. Basic Economic Review

The basic economic theory of pollution control is well developed. [5] The purpose of this section is to summarize some key points of economic theory to provide the necessary framework for analyzing the structure of Estonian policy and policy concerns. This section could be skipped over by the reader not interested in economics, but this framework fits exactly the logic of Estonian policy and helps to identify key problems that Estonia faces as it attempts to implement its current pollution control policy.

Consider first the case of an unregulated enterprise. To put it simply, since pollution can be thought of as just another output of an enterprise, it is assumed that the enterprise chooses a pollution strategy to maximize benefits to the enterprise (income, profits). Mathematically, for example, this problem can be written as:

$$\max_{p} \; B(p) \quad - \quad B'(p^{u}) \quad = \quad 0 \quad \textbf{(0)}$$

where the function B(p) represents the enterprise's net benefits from pollution generation, B'(p) represents marginal benefits of pollution. This first-order condition shows that benefits are maximized where the benefits of an additional unit of pollution equal zero at pollution level p^{u}. The term B' (p) can be thought of as the enterprise's demand for pollution, just as any demand schedule represents marginal benefits of an additional unit of the commodity in question. Conversely, the term B'(p) can be thought of as the marginal costs of pollution abatement to the firm, since B' (p) shows how much benefits the enterprise must give up to reduce pollution by one unit.[6]

[5] Tietenberg (1992, Chapter 12) provides a thorough introduction to the topic.

[6] If pollution is directly related to output in fixed proportions, say as q = ap, then q units of output are equal to ap units of pollution. In this case, marginal cost of abatement of one unit of pollution is equal to the benefits (e.g. profits) lost from producing 1/a units of output. However, flexibility in the production process allows greater efficiency in the use of certain inputs, an additional unit of pollution can be reduced for less than 1/a units of output.

Continuing with the textbook example, now assume policy makers are concerned with the socially "efficient" level of pollution defined as the level of pollution that maximizes net social benefits from pollution control. [7] Social efficiency takes account of the damages that such pollution creates. Assuming that these benefits and costs can be translated into the same units (e.g. monetary units), society's problem becomes:

$$\max_p \; B(p) - D(p) \quad B'(p^s) = D'(p^s) \quad \textbf{(0)}$$

From society's perspective, the efficient level of pollution occurs where marginal benefits of pollution creation equal marginal social costs of such pollution. Or, conversely, social efficiency occurs where the marginal costs of pollution abatement equal the marginal benefits of such abatement (in terms of reduced damage).

By definition, the socially efficient level of pollution balances the benefits and the costs of such pollution. And, in this simple context, the efficient solution can be reached by either allowing the firm to generate p^s units of pollution (a pollution ***standards approach***) or making the firm pay a charge on each unit of pollution equal to marginal social damages evaluated at p^u units of pollution (a pollution ***charge approach***). This charge on each unit of pollution, $D'(p^s)$, is often referred to as a ***Pigouvian pollution tax.*** Of course, a ***mixed system*** of both charges and standards could be used.

These relationships between marginal pollution benefits and costs are presented in Figure 1. Two different possibilities are represented by the marginal benefit schedule B'(p) for enterprise B and b'(p) for enterprise b, depending on the enterprises structure--technology and management. For both cases, an enterprise would choose pollution level p^u in the absence of any environmental policy, where marginal benefits of an additional unit of pollution are zero. From Figure 1, the marginal and total benefits of pollution for enterprise B are always less than the marginal and total benefits of pollution for enterprise b.[8]1While the benefits of pollution are always greater under Case b, Figure 1 does not directly determine whether overall benefits to the firm are greatest in Case B or Case b. For example, in comparison to a firm that relies on old and poorly maintained technologies and is managed poorly, it is entirely possible that modern, well managed

[7] Of course, this may be a big assumption. If for some reason, society knows the level of pollution it wants, then society's strategy should be to minimize the costs of achieving a given level of pollution. Of course, it may also be incorrect to assume that society agrees on the "right" level of pollution.

[8] Note, the total benefits of pollution are represented by the area under the marginal benefits schedules in Figure 1. While the benefits of pollution are always greater under Case b, Figure 1 does not directly determine whether overall benefits to the firm are greatest in Case B or Case b. For example, in comparison to a firm that relies on old and poorly maintained technologies and is managed poorly, it is entirely possible that modern, well managed plants with the latest technology pollute less for every level of output as mentioned above.

plants with the latest technology pollute less for every level of output as mentioned above.[9] Therefore, the costs of controlling pollution are always less for enterprise B.

Costs of controlling pollution can be less for enterprise B than for enterprise b for at least four main reasons. First, enterprise B can produce a different type of product that either uses less polluting inputs or generates less pollution in the production process. Second, enterprise B can produce the same output, but have newer technology that uses different inputs or the same inputs more efficiently to generate less pollution per unit of output. Third, the enterprise may have already invested in some end-of-pipe pollution control technology that reduces pollution per unit of output. And fourth, the enterprise may have exactly the same technology, but is just better managed so that the greatest efficiency is obtained for the same technology.

Figure 1 is useful for emphasizing several points. First, several types of information are needed and assumed to be known. Perhaps the most important assumptions are that:

pollution is easy to define and monitor, and marginal abatement costs and marginal damage costs are known by the enterprise and the environmental policy authority.[10]

If pollution cannot be monitored and enterprises do not know their marginal abatement costs, it is virtually impossible for pollution charges to create any desired incentives for pollution abatement or for pollution (emission, effluent) standards to be achieved in a cost-effective manner. Both of these assumptions, monitoring and knowledge of marginal abatement costs, are likely to be violated in some countries in transition, where monitoring equipment is lacking and continuing state-owned enterprises have had and continue to have poor financial accounting practices[11].

Second, for the same marginal damage function, the efficient level of pollution depends directly on the firm's marginal benefits from pollution (marginal cost of pollution abatement). When it is relatively easy for firms to reduce pollution (firm B), the efficient level p^B for firm B may substantially less than the unregulated level. When it is relatively costly from firms to reduce pollution (firm b), the efficient level of pollution for firm b, denoted p^b in Figure 1 may not be much different than the unregulated level p^u. Thus, a "correct" Pigouvian tax does not necessarily imply a large--or any--reduction in emissions for an existing marginal abatement cost function.

Third, with a pollution charge system, more revenues are collected when the marginal cost of pollution abatement is relatively steep (firm b compared to firm B). In effect, pollution control policy costs more in economies with high abatement costs such

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[10] Pezzey (1988) provides a good summary of underlying assumptions of this type of model.

[11] For policy based on pollution standards, charges, or some combination of both, much of the same type of information is needed for the policy to be effective. If just a standards approach is followed, it is still necessary to determine the standard, monitor emissions, and enterprises need to know abatement costs. Marginal damages must also be know to follow a tax approach.

as Case b (both higher damage costs and higher abatement costs), but the government can acquire more revenues. For all practical purposes, environmental economic theory provides little guidance as to what to do with these revenues given the reality of governmental budgeting system in most countries. Should the money go to a central budget, should it go for public investment in sewerage treatment plants, environmental monitoring systems and national parks, and/or should it be channeled back to enterprises for environmental investments? There is of course a large amount of literature available on this topic, but there is no final correct answer, nor should one be expected without taking into account the economic, political, and administrative context of a specific country (Opschoor, 1993).

Fourth, the ***polluter pays*** approach to environmental policy, recommended by the OECD and part of European Union environmental policy, is directly consistent with a standards approach but it not clearly related to a charging system. Following Pezzey (1988), the basic polluter pays approach implies that firms are responsible for paying their costs of pollution abatement (area p^BAp^u for enterprise B), which happens with a pollution standard approach. With an extended version of the polluter pays principle, the firm could also be charged for damages (the area FAp^B). This payment for damages implies, essentially, a ***strict-liability rule*** for environmental policy.

However, neither version of polluter pays is directly related to a Pigouvian charge system, where all units of pollution are assessed the charge. For example, for Case B with a Pigouvian tax level, the total level of pollution charges paid by the enterprise is represented by the area $0A'Ap^B$ in Figure 1, which is greater than the total level of damages caused by pollution represented by the area FAp^B. This additional payment 0A'AF is a tax on the enterprise in addition to pollution damages.[12]

From a public finance point of view, there is not necessary anything wrong with a Pigouvian tax that collects more revenues than social damages, since this tax provides creates the right social marginal incentives in the economy. In fact, environmental taxes could be more clearly integrated with non-environmental taxes to achieve a less distortionary tax system. Perhaps an eventual outcome of such integration would be a system where environmental taxes could provide incentives to reduce pollution and provide revenues so that other more distortionary taxes could be reduced. This point follows directly from the OECD report on taxation and environment, which concludes that "there are substantial gains to be made from the integration of taxation and environmental policies" (OECD, 1994, p. 12) .

And fifth, under both a charge system or a pollution standard, the total costs to the firm of complying with the policy create an incentive for a firm to innovate, through investments in better management and technology, to reduce the costs of the pollution regulation on the firm. For this simple framework, as discussed above, a Pigouvian tax policy always creates more total regulatory costs to a firm than a pollution standard. As a result, the total benefits of investment and innovation that reduce pollution abatement costs are always larger with a Pigouvian tax as compared to a standard for this simple

[12] In principle, as Pezzey (1988) suggests, a simple two-step pollution charge could be used to provide the rights incentives for pollution control while reducing the tax burden on enterprises.

model.[13] Whether any investment actually takes place depends on whether the investment costs are less than the benefits to the enterprise. Just because a tax creates more incentives, it may not create enough incentives for enterprises to pay for the investment particularly given the often thin credit markets available to enterprises in transition economies. In effect, then, raising charges does not create an automatic incentive to invest and could, in fact, reduce an enterprises ability to invest if it was also paying higher charges.

III. Estonian Pollution Policy: On "Paper" and On the "Ground"

Based on this brief economic review, we can now move on to an analysis of Estonian pollution policy, which is based primarily on a series of framework Acts, Governmental and Ministerial Regulations, and other policy statements such as ministry orders and procedures. In general, County Environmental Departments are responsible for implementing and enforcing these policies to ensure compliance with the system.[14] Thus, to analyze Estonian pollution policy, it is necessary to analyze both what is "on paper" in laws and regulations and what happens "on the ground" in the counties. We begin with the main umbrella law, the Act on Pollution Charges and move to the main governmental and ministerial regulations designed to implement the law. Based on the emerging experience with implementing this policy, we then summarize a few key and basic issues that Estonia must address to improve implementation, enforcement, and effectiveness of its policy.[15]

[13] See Tietenberg (1992, Chapter 14) and Pezzey (1988) for a more complete discussion of incentives for pollution control under pollution charges or standards for this type of simple model.

[14] There are currently 17 administrative units below the national level (15 counties or districts and the two largest cities--Tallinn and Narva). For this paper, these 17 administrative units are called "counties" in English.

[15] To complete this analysis, interviews and discussions were held with all the key players involved with developing and implementing this policy. Ida Virumaa and Laane Virumaa were the two countries of focus, which is where most of the large polluters in Estonia are located and where the majority of pollution charges are collected.

A. The Act on Pollution Charges (the umbrella law)

The basic framework law for pollution control is the **Act on Pollution Charges** (Resolution No. 244 of the President of the Republic of Estonia, December 19, 1993, effective January 1, 1994).[16] The stated purpose of the act is to restrict disposal of polluting substances into the environment through economic measures and to obtain additional revenue to finance environmental protection. The framework law sets out the basic characteristics of pollution control policy based on a system of pollution permits and pollution charges. This law also specifies the responsibilities of the Government and the Ministry of Environment for the development of specific regulations to implement the Act.

It is perhaps best to summarize first the basic, simple, structure of this system of permits and charges, specified both in this umbrella law as well as its related regulations, before moving on to further details of the law and regulations. While the details vary somewhat depending on the nature of the pollutant (air, water, solid waste, sea), the basic characteristics of pollution policy in Estonia can be summarized as follows:

- enterprises are responsible for requesting from their County Environment Department (CED) a permit for specific amounts of different pollutants;

- based on this requested amount, a pollution permit maybe granted to the enterprise for a fixed period of time (1-5 years usually);

- in the permit, threshold levels of pollutants (tons per year or quarter) are defined and concentration limits (grams per second, milligrams per liter) are defined for some situations as well;

- the enterprise pays a constant unit pollution charge for each unit of pollution up to the threshold amount in tons per period (the base charge), and the enterprise pays a higher unit charge for those units of pollution above the threshold level (the penalty rate);

- an enterprise does not violate any law by polluting over the threshold level, it just must pay a higher rate; and

- the enterprise is responsible for reporting its pollution amount quarterly and paying the required pollution charges to the CED.

[16] The exact translation between Estonian and English has not yet been officially determined in Estonia. There is no official translation of Resolution 244. One possible translation is "Act on Compensation for Pollution Damages", another is "Act on Pollution Charges", with Act and Law being used interchangeably in different Estonian translations. For the purposes of this paper, either translation is adequate.

These pollution charges are the main revenue source for the off-budget Estonian Environmental Fund. Within the national fund, the revenues are split 50/50 between the central fund and the respective county funds. In principle, there are sanctions for late payment based on 0.2% daily interest rate for late charges. After 3 months, the case can be taken to a court (administrative court) for a decision. There are several more detailed differences between different types of pollutants that will be identified and discussed later in the text. Pollution charges are paid quarterly and are indexed to the previous year's consumer price index, which helps to mitigate the impacts of inflation on real charge rates. Inflation was higher than expected in the first quarter of 1994, and it is likely that the base rates should increase 40-50 percent in 1995 to reflect the 1994 consumer price increase.

Figure 2 summarizes the basic economic incentives intended in Estonian law.[17] In effect, Estonian pollution policy creates a two-step "pollution damage" function in general (and a three-step function for effluent to be discussed later). For pollution levels below or equal to the threshold level p^l, the firm pays the base pollution charge equal to c^l. For levels above the threshold level, the firm pays the higher penalty rate c^h. This discontinuity in the damage function (the pollution charge schedule) creates no major problem for the basic analysis.

Given this structure of pollution damages, three basic outcomes are possible depending on the structure of the firm's marginal benefit function (marginal cost of pollution abatement). If the firm's marginal benefit function is B'(p), then an interior solution occurs at pollution level p^B and the firms total benefits are $B(p^B) - c^B p^B$. If the firm's marginal benefit function is b'(p), the firm chooses the permitted level of pollution p^l and total benefits are $b(p^l) - c^l p^l$. And, finally, if the marginal benefit function is H'(p), the firm chooses pollution level p^H, and the firm's net benefits are $H(p^H) - c^h(p^H - p^l) - c^l p^l$. If the jump in charges from the base rate to the penalty rate is high enough, and the firm has some ability to reduce pollution, this policy may create an incentive for firms to pollute at or below the permitted level p^l and pay the base charge rate c^l.

The Pollution Charge Act assumes that pollution in Figure 2 is defined, clearly understood, and can be monitored by both the enterprise and the CED. The Act gives the responsibility to the government and the Ministry of Environment to specify the details of the system (charge rates, threshold levels, permit procedures, and monitoring requirements). Before moving onto these more detailed regulations, there are several important clauses in the Pollution Charge Act that are worth mentioning here.

The Pollution Charge Act contains a ***strict liability*** clause, where enterprises remain liable for paying compensation equal to pollution damages to another party due to the enterprise's pollution. Having a permit, and operating within the threshold levels does not eliminate this liability (as a ***negligence*** approach might imply). Currently, this clause seems to receive little attention, perhaps due to the vagueness of the definition of damages, burden of proof, and underdeveloped legal system. It is likely, however, that this clause will gain importance in the future as the legal system develops.

[17] The pollution damage function in Figure 2 does not include the possibility for additional liability from third-party damages from the firm's pollution that exists in the Act on Pollution Charges.

There is a clause in the Act where enterprises can receive a pollution charge allowance for investments that would be expected to reduce pollution by at least 25 percent from the previous year's pollution level. [18] The intent of the pollution charge allowance can be summarized in terms of Figure 2. Assume that $p^b = 0.75p^H$, so that a switch from technology H(p) to b(p) satisfies the eligibility requirements for a pollution charge allowance. In Figure 2, the amount $(c^h - c^l)(p^h - p^l)$ shows how much pollution charges will decline with a change in technology from H(p) to b(p). In principle, if the investment cost, I, is less than the reduction in pollution charges associated with the switch, $0 < I \leq (c^h - c^l)(p^h - p^l)$, the firm should already have an incentive to invest in technology b(p).[19] However, since the firm has not already made the switch, it is more likely that $0 < (c^h - c^l)(p^h - p^l) < I$.

Now, based on the law, the firm could qualify for a pollution charge allowance equal to its current year's expected pollution charge, which equals $c^h(p^H - p^l) + c^l p^l$ from Figure 2. If investment costs minus the pollution charge allowance is less that the benefits from switching technologies, and paying less pollution charges in the future, the pollution charge allowance creates an incentive for a firm to request a pollution charge allowance and invest in technology b(p). Mathematically, this decision rule can be stated as: apply for the pollution charge allowance and invest in technology b(p) if:

$$0 \; < \; I - \; c^h(p^H - p^l) - c^l p^l \; \leq \; (c^h - c^l)(p^h - p^l).^{20}$$

It is perhaps important to note that a pollution charge allowance is directly consistent with the polluter-pays principle discussed in Section 2 and could be one way to combine a "stick" and "carrot" approach to pollution control policy. The pollution

[18] The first such pollution charge allowance was recently completed with Nordic Cement, a privatized company undertaking substantially investments in new technology--both production and end-of-pipe pollution control--in Kunda (Laane Virumaa). This initial charge allowance is not, in reality, a good example where the charge allowance created incentives for environmental investment. In the Kunda example, the investment plan was already determined by the enterprise, but then its total pollution charge increased substantially from one year to the next (due in part to a regulation change and in part to a change in its permit). Rather than assessing these higher charges, the Minister of Environment and the company concluded an agreement to allow a pollution charge allowance to get around this unexpected jump in charges. However, it was possible to adjust the timing of investments as part of the charge allowance so that investments with localized benefits will be completed earlier than originally planned.

[19] More generally, in a dynamic model, some form of expected present discounted value of the reduction in pollution charges would be compared against current investment costs and future operation and maintenance costs.

[20] If the pollution charge allowance in the first year is not sufficient to cover all of I, then the pollution charges in following two years can also be reduced until the undiscounted sum of total pollution charges equals I. Again, for this more detailed dynamic case, it would be necessary to compare the expected present discounted value of the total future reduction in pollution charges and the expected present discounted value of investment that includes the option of the three-year pollution charge allowance. If the investment in pollution control, and/or changes in the pollution permit allows the enterprise to stay within in the threshold level of pollution in the future, then the value of the charge allowance in the second and third years would be relatively small.

charges are the "stick", which may be wielded on the enterprise, but the pollution charge allowance is the "carrot" that entices the enterprise into pollution control. For the carrot to be a desirable option for the enterprise, though, it is necessary for the policy stick to be held by the CED. Of course, as described above, whether a pollution charge allowance alone actually creates any investment depends on if the investment costs are less than this reduction in pollution charges plus additional reductions in charges granted in the pollution charge allowance.

There are, however, many potential problems with implementing a pollution charge allowance. For example, it does not necessarily create any incentive for an enterprise to find the least cost way of reducing pollution. It is also likely that an allowance will tend to be granted to finance end-of-pipe clean up technology, which is easy to identify as an environmental investment, rather than direct win-win investments in enterprise production and management efficiency that reduces pollution as a by-product of reducing costs and increasing profits. The Ministry is aware of this potential problem. Time will tell if this problem can be avoided.

The pollution charge allowance clause, as written in the law, does acknowledge that pollution depends on many factors and is not deterministically chosen at the start of a year. As a result, the exact definition of "reduction" is left somewhat vague, which allows a reduction to be defined in many possible units (e.g. concentration of effluent, total tons of pollutant, or amount of pollutant per unit of output).

It is important to mention the relationship between basic income tax and value-added tax laws, which also continue to be revised, and environmental charges and incentives for pollution control. The main tax law of interest is the **Income Tax Law** (Resolution No. 237 of Dec 21, 1993; in force Jan 1, 1994). The main relationship between the tax law and pollution charges law has to do with an allowable expense. In general, enterprises pay a 26 percent tax on "taxable income", where taxable income is defined in relation to gross income and deductible operating expenses (called entrepreneurship expenses).

Article 13, clause 1 of the tax law states that entrepreneurship expenses are "documented expenses incurred by the tax payer relating to his entrepreneurship during the period of taxation." Article 16, clause (4) states that:

> penalties applied under law, interest specified in the law on taxation and compensations for damaging the environment (translated directly as "**pollution charges**") are not considered to be entrepreneurship expenses and are not a valid expense for tax purposes."[21]

Thus, pollution charges are penalties in the tax law. In effect, the government believes industrial production and supplying municipal services can occur without any level of emissions or effluent, and thus all levels are considered to be unacceptable. Therefore, any charges paid on pollution are grouped with other "penalties" and are not considered to be a valid expense. In reality, this concession on pollution charges being paid from after

[21] As a side note, natural resource use charges are considered to be valid expenses for tax purposes.

tax profits was necessary to get the pollution charges law approved by the State Assembly (Parliament, Riigikogu). However, Estonia missed a good chance to integrate environmental concerns more directly into the broader tax code.

One main implication of pollution charges being paid out of after tax profits is that the real unit cost to the enterprise of pollution charges is about 35 percent higher than the nominal price specified in the regulations.[22] In terms of Figure 2, both the base charge rate and the penalty charge rate should be increased by about 35 percent, which makes a substantial difference for the real charge rate for more hazardous pollutants over threshold levels in permits. Assuming that the Government and the Ministry of Environment chose the nominal pollution charge based on its best assessment of an adequate charge level from enterprises, it could be argued that pollution charges should be reduced by about 35 percent.

It seems likely that, given the current economic circumstances in Estonia, some enterprises will argue that they cannot pay charges due to operating losses (no profits). The Pollution Charge Act does not specify what to do when enterprises do not have any "after tax income" as defined in the income tax law. If an enterprise has no income, how can it pay pollution charges and why would additional penalties for late payment create any incentives to pay? Of course, there can be a big difference between actual income and taxable income for an enterprise just as for an individual. As a related point, Article 21, clause 1 in the tax laws states that losses occurred in any year (a situation of negative taxable income) can be carried forward for up to five succeeding periods of taxation. Thus, a loss in one year allows lower and perhaps negative profits for the following five years.

The income tax law allows a 40 percent annual depreciation allowance on assets (clauses 17(2) and 17(4)). Thus, this 40 percent depreciation allowance combined with a 26 percent income tax rate reduces total investment costs by about 10 percent through its impact on taxable income if the enterprise has taxable income.

The **Law on Value-Added Tax** (passed in August 1993) which has also been amended several times since, specifies a basic 18 percent tax on the selling price of goods and services. Thus, this tax is simply a sales tax on total value. Under Article 5, clause 1, goods and services sold for "treating dangerous waste" is exempt from this 18 percent tax. This seems to be a very important clause for incentives to purchase "goods and services" for "treating dangerous waste". Anything that reduces the cost of pollution control by 18 percent must be considered very important.

Unfortunately, the law does not define exactly the term "treating dangerous waste". The latest revisions of the "Regulations on Implementing the Law on Value-Added Tax", based on input from the Ministry of Environment, begin to identify this term. The Ministry of Environment should seriously take another look at the definitions they are providing to the Ministry of Finance. Although pollution is by definition a waste and potentially dangerous to human health and the environment, otherwise there would be no need for any government policy, the current definition is not very clear and could be

[22]The 35 percent number comes from the fact that a profit-maximizing enterprise will makes decisions based on the after-tax pollution charge, which is 1/(1-0.26) = 1.351 higher when paid out of after tax profits.

read in a very exclusive way. Thus, currently most goods and services purchased for pollution control include an extra 18 percent VAT charge. Trying to define clearly pollution control activities that could be exempt from this VAT charge would help to create an economic incentive for pollution control activities, by reducing the costs of this activities.

As a final note on the Pollution Charge Act, the total costs to enterprises of pollution charges based on the threshold levels of pollution and the base rates cannot exceed 0.5% of Gross Domestic Product of the previous year. For reference, GDP in 1992 was estimated at about 14.25 billion Estonian Kroons (EEK), which is a little over one billion dollars U.S. at current exchange rates of 13.5 EEK/$ in early 1994.[23] So, for 1992, this limit on planned pollution charges would equal a little over 65 million EEK (about five million U.S. dollars). GDP at current market prices in 1993 and projected for 1994 are somewhat larger than 1992. Nonetheless, the total GDP constraint would be in a range less than $10 million. For reference, in 1993, about 19 million EEK were collected in pollution charges, which included both base and penalty charges. So, for practical purposes, the GDP constraint on pollution charges has no effect on pollution charges and permits.

While the basic principles of pollution policy are specified in the Pollution Charge Act, the Act specifies the need for a Governmental Regulation to determine certain pollution charge rates (base and penalty rates), and Ministerial Regulations to specify: (1) procedures for acquiring a permit; (2) pollution charges not specified in governmental regulation; (3) procedures for calculating and paying the charges, based on the rates determined by the Governments Regulation; and (4) the specifics of the pollution charge allowance. Most of these regulations have been developed and passed. It is unlikely that a formal pollution charge allowance regulation will be developed. The possibility of obtaining a charge allowance will remain more informal, based on negotiations between an enterprise, the CED, and the Ministry of Environment, with the Minister of Environment retaining final approval authority.

B. The Governmental Regulation on Pollution Charge Rates

From the Act on Pollution Charges, the main Government Regulation is the **Pollution Charge Base Rates** (Governmental Regulation #45, passed by the Government of Estonia on 8 Feb 1994). This governmental regulation specifies in appendices the pollution charges for several key types of air, water, and solid waste pollution. Every year starting January 1st of 1995, the Ministry of Environment together with the Ministry of Finance must adjust the base rates according to the yearly change in the consumer price index from December to December of the previous year.

For reference, Table 1 reports these pollution charges for air and water 1994.[24]

[23] Ministry of Economic Affairs (1994).

[24]Solid waste charges have the same basic structure as air and water pollution, where charges are assigned according to hazardous class. Charges range from 0.5 EEK/ton for inert nontoxic solid waste to 420 EEK/ton for hazardous class 1 solid wastes. Oilshale pollutants have specified extra charges. A distance factor from certain types of places is also assessed. If an enterprise does not have a pollution

Table 1: Pollution Charges Specified in Governmental Regulation

Air Charges (from Appendix 1 of regulation)[25]

Pollutant	Base Rate Charge with a Permit (EEK/ton)
Nitrogen oxide	33.60
Soot	21.00
Oilshale ash	14.70
Sulphur dioxide	14.70
Non toxic dust (particulate)	10.50
Carbon monoxide	2.10

Water Charges (Appendix 2 of regulation)

Pollutant	Base Charge with a pollution permit (EEK/ton)
Phenols	4200
Oil products	1200
Phosphorous (P)	900
BOD7	600
Nitrogen (N)	500
Suspended Solids	300

permit or its actual amounts are above its permitted amounts then the charges are multiplied by a "penalty" factor which ranges from 5 to 500 according to hazardous class.

[25] Air pollution charges are multiplied by a location weight to determine the final base rate of a given location. For reference, the location weights are:
2.5 for Health resort towns (Haapsalu, Kuressaare, Narva-Jôesuu and Pärnu);
2.0 for Tallinn; 1.5 for Ahtme, Jôhvi, Kiviôli, Kohtla-Järve, Narva, Püssi, Sillamäe and Tartu; and 1.2 Eesti and Balti Electric Power Plants.

Sulphates	20

For all types of air pollutants, not just those identified in this government regulation, the penalty charge for pollution amounts over the threshold level defined in a permit are a multiple of the base charge depending on the pollutant's hazard class (four hazard classes). For reference, these multiples are: 5 for the 4th hazardous class; 50 for the 3rd and 2nd hazardous classes; and 500 for the 1st hazardous class. In this regulation, it is also specified that all emissions occurring without a permit are assessed the penalty rate.

For most types of water pollutants, the penalty charge over the threshold level are multiplied by a factor of five. If an enterprise is without a pollution permit then the total amount is calculated at the corresponding charge rate multiplied by a factor of 10. Shipping activities which emit oil products into the sea are charged the maximum base rate times a factor of 50. Heavy metals and other toxic substances which are over the permitted amounts or are without a pollution permit are assessed the maximum charge base rate associated with phenols of 4200 EEK/ton times a factor of 1000.[26]

For water pollution, the Government of Estonia is trying to provide incentives to enterprises to reduce pollution to a certain level by having no pollution charges on levels which are below the following:

Pollutant	Effluent Standard above which Pollution Charges are Assessed (mg/l)
Phenols	1.0[27]
Oil products	1.0
Phosphor (P)	1.5
BOD7	15.0
Nitrogen (N)	12.0
Suspended Solids	15.0
Sulphates	100.0

For reference, these effluent concentration levels follow from Helsinki Commission standards.[28]

[26] Charges are also assessed on the pH level of effluent if it is above or below the pH range of six to nine (0.10 EEK per 0.1 pH unit/m3 of effluent).

[27] This standard recently changed for phenols to 0.1 mg/l for a somewhat different definition of phenols, as reported officially in the Riigi Teatija (94, Number 69, Article 1199, 21 October 1994).

[28] HELCOM (Helsinki Commission) was established by the Baltic Sea countries to reduce pollution loads in the Baltic Sea. Related to HELCOM, Estonia signed the "International Water Protection Cooperation Agreement" with Finland on the 9th of April 1992 in which Estonia agreed to several conditions related to the effluent concentration standards in this government regulation.

Notice that these HELCOM-related effluent standards, which are perhaps better thought of as "guide values", are based on pollution ***concentrations***, while the pollution charges specified in the government regulation are based on tons of pollutant. The two different definitions of pollution (tons per quarter and mg/l) are brought together in the pollution permit, where total quantity of water discharge is supposed to be identified. For example, if an enterprise was allowed 1000 liters total of water effluent discharge, and 3000 milligrams of an oil product was the threshold level in the pollution permit, the first 1000 milligrams of an oil product would be assessed no charge, and the oil product above 1000 up to 3000 milligrams would be assessed the base charge rate. Anything above 3000 milligrams would be assessed the penalty charge.

There are cases where the threshold level of pollution identified in a pollution permit imply concentration levels that are more stringent than the concentration standards defined in the governmental regulation. Returning to the above example, it was possible in the past that the threshold level defined in the pollution permit was only 500 milligrams of the oil product, which is less than the 1000 milligrams implied by the concentration standard of 1.0 mg/liter. When this happened, the amount discharged above 500 milligrams could have been assessed the full penalty rate defined in the government regulation (5 times the base rate).

A policy statement on this relationship between threshold levels (in tons per quarter) and effluent concentration standards was recently made more explicit. In general, a government regulation was approved during December 1994 where Estonia adopts HELCOM standards as official policy. There is a phase in period, where threshold levels in permits can be above that implied by the concentration standard until 1 January 1997, threshold levels cannot be below the standard without government (not just Ministry of Environment) approval. Concern has been raised that, while these standards may encourage enterprises to reduce their effluent concentration levels to the standard, it does not encourage enterprises to reduce levels any further. Since many point sources discharging to the same water body could all be within the standard, overall water quality could decline in some surface waters. As a result, some counties are worried that this existing policy encourages a further degradation of their county environment up to stated concentration standards. However, from what we have been able to find, there has been no analysis to know: (1) whether effluent concentrations below the standards could actually have important and positive environmental impacts; and (2) whether the additional costs to enterprises of meeting such more stringent standards are worth the environmental benefits.

It should be noted here that this three-step pollution charge approach for water effluent does not create incentives for enterprises to reduce pollution to the HELCOM-related standard when pollution abatement costs to achieve the standard are high and the base charge rates are relatively small. The main result of this approach is that enterprises are given a water effluent charge allowance that does not depend on any reduction in pollution. Enterprises that produce air emissions must wonder why they have to pay for all levels of emissions.

In sum, charge rates are specified more or less clearly for some pollutants in this government regulation, while little guidance on threshold levels written directly in the Pollution Charge Act. Since there can be very large differences between the base rates

and the penalty rates, depending on a pollutants hazard class and the enterprise's location, this threshold level is key to the pollution permit and charge system. For guidance on permits and threshold levels, it is necessary to look to ministerial regulations.

C. Ministry Regulations on Pollution Charge Estimation and Permitting and Payment Procedures

The **Pollution Charge Estimation and Payment Procedures** (Ministerial Regulation #3, passed by the Minister of Environment on 28 Feb 1994.) was passed to define other pollution charge rates, and methods of calculating charges, collecting charges and submitting charges to the Environmental Fund. The **Procedures for Issuing Water Permits** (Ministerial Regulation# 2, passed by the Minister of Environment on 28 Feb 1994) gives several responsibilities for implementation and enforcement to the County Environmental Departments, including issuing permits, determining threshold levels and time period of permit, and some monitoring of pollution levels.[29]

In sum, enterprises must apply for a permit to the CED, self report their pollution levels, calculated their charges, and pay on time to the CED. The details of the system are somewhat different for air, water, and solid waste. Most of the following discussion will focus on air and water permits, although similar issues discussed below pertain to solid (and hazardous) waste as well.

The most important point to emphasize here is that no policy exists on ambient environmental quality goals, it is difficult to determine if threshold levels chosen in pollution permits are consistent with any policy goal. More specifically, ambient surface water quality goals do not exist, although some form of effluent standards have been made explicit as of 1997 based on HELCOM effluent standards. On the other hand, old Soviet-period ambient air quality standards do exist, but as discussed below may not be appropriate for today's market economy, while some formal policy on emission standards does not exist. It is not automatically clear that systematic environmental quality goals are needed, such as ambient air and surface water quality standards. Instead, perhaps it is best to leave such choices to the discretion of each environment department. At the same time, it is almost impossible to explain to enterprises exactly why a certain threshold level was chosen, and the possibility for severe inconsistencies between enterprises in the same county and across counties will arise.

[29] Another new law is the **"Water Act" #342, passed by Riigikogu on 11 May 1994 and signed by the President of Estonia on 30 May 1994.** This law is very generic, vague, and contains several contradictions. A key point in this law is that all discharges of pollutants are defined as a special use, and permits are needed for all special uses except that associated with household effluent disposed of on the household's property.

Air Permits

Regarding air, there is currently some link between ambient air quality goals and threshold levels in air permits. Charges for air pollutants and guidance on threshold levels are based on a list of Estonian ambient air quality standards.[30] There are three types of ambient standards: a twenty-four hour average (LPK_k); a one-time maximum (LPK_m); and a workplace standard (LPK_t). These standards, which date from Soviet times, exist for about 181 different pollutants organized into four hazard classes. For reference, key pollutants and Estonian ambient standards are provided in Table 2 in comparison to those of the World Health Organization, the European Union, and the United States.

Table 2: Ambient Air Quality Standards (micrograms per cubic liter)[31]

	LPK_m	LPK_k	LPK_t	WHO	EU	USA
so2	500	50	10000	125	100-150	365
co	5000	3000	20000	10	?	10
nontoxic dust	500	150	6000	100-150	80-130	50
no2	80	40	2000	150	50-200	100

There is probably some room to reevaluate the Estonian ambient air quality standards. The standard for SO2 and NO2 (LPK_k) may be too strict, while that for CO may be too loose.

[30] An air pollution permit is required when the pollution being emitted is greater than the "minimal measured pollution quantities" which can be found in Estonia's air pollutants' standards.

[31] The standards reported for the EU, WHO, and US are taken from UNEP/WHO (1992). These standards, while based on some form of a 24-hour average, are not exactly comparable due in part to definition of pollutant and sampling method. The exact details of differences are explain in the UNEP/WHO report.

For air pollutants not specified in the governmental regulation, charges rates per ton of pollutant emitted (T) are based on the following formula:

$$T_i = T(SO_2) * \frac{\sqrt{LPK_k(SO_2) * LPK_t(SO_2)}}{\sqrt{LPK_k(i) * LPK_t(i)}} = \frac{10300}{\sqrt{LPK_k(i) * LPK_t(i)}}$$

where

T = pollution charge rate in Estonian Kroons (EEK) per ton;
i = any pollutant not specified in government regulation;
SO2 = relevant variable for sulphur dioxide;
LPK_k = pollutant's 24-hour average permitted concentration, micrograms/m^3;
LPK_t = pollutant's permitted work zone concentration, micrograms/m^3. [32]

Now, while LPK_k and LPK_t are used to specify charges, LPK_m is used to define the threshold level in the pollution permit. For reference, the process to receive a threshold level in an air permit can be divided into three steps. First, the enterprise requests a threshold level of pollution in its permit. Presumably, this request is based on expected production plans and input use for the year. Any rational enterprise manager would request some amount extra for insurance in case production is larger than planned. Second, based on the emission rates implied by this level of pollution, a dispersion model of ambient air quality is supposed to be used to determine whether this emission rate would lead to a violation of the LPK_m standard at any time during the year. In principal, conditions--temperature, wind speed and direction, emissions from other polluters-- used to parameterize the model are based on worst case scenarios. And third, as long as LPK_m is not estimated to be violated for the worst case scenario, the threshold level requested by the enterprise is approved. Approximately 5 dispersion models have been "approved" by the Ministry of Environment for conducting these air quality modeling exercises. The quality or validity of these models is not clear.

This worst case scenario approach to giving air permits may need some reevaluation. For example, it is possible that the maximum would be expected to be violated only a very small quantity of time during a year, but in general a large quantity of days would be very good. However, this permit would be rejected. On the other hand, another firm could request a permit where the maximum is not expected to be exceeded, but a large quantity of days would be close to the maximum, and this permit would be

[32]So, the total payment (S) for each pollutant is calculated as: S = kMT, where
T = pollution charge rate, EEK/ton;
k = locational weight specified in appendix #1 p.2 of "Pollution Charge Base Rates" #45;
M = quantity of pollutant in tons less than or equal to the threshold level (defined here as m). If the enterprise exceeds the threshold level, the total charges become: S = kmT + kp(M-m)T, where p is the penalty multiple of the base rate.

approved. In terms of human health, it is not automatically clear what is a better policy. In should be noted that in some areas, such as the European Union, ambient air standards explicitly incorporate this probabilistic nature of pollution directly into the standard.

At the end of each quarter on the 10th of the next month (January, April, July, and October), the enterprise is to supposed to submit to the County Environmental Department its emission quantities along with documentation and written calculations of its pollution charges.[33] The County Environmental Department is supposed to control the validity of the received data, make corrections as necessary, and register the charge calculations. Disagreements between the Environment Department and the enterprise over differences in calculations are discussed later. If an enterprise does not submit all the required information, the Environmental Authority is supposed to calculate and register its own measurements and figures for the enterprise. The CEDs have a budget to conduct a small scale monitoring program as well for key point sources in their counties. If there are disagreements over the charge estimations or payments between the Environmental Authority and the enterprise then both parties have the right to make a formal complaint to the Ministry of Environment. The Ministry is supposed to respond within 30 calendar days or it can extend the time period.

Water Permits

For water, there are no ambient surface water quality standards to provide any form of guidance to the CED for issuing permits and threshold levels. In general, pollution charges need to be paid for pollutants discharged into water bodies or land that might endanger human health or the state of the environment, although "endanger" is not really defined. The Water Pollution Act, however, defines all discharges of polluting substances as a special use, which as a result need a pollution permit. To date, the CED staff determine threshold effluent levels, which as a result are region and enterprise specific. The process is perhaps best described as a negotiation. The enterprise is supposed to conduct a study or have a study done on its production process with its existing technology to determine the amount of pollutants generated as a result of its production expectations for the year. The enterprise then requests in its permit a threshold level that would satisfy this expected amount, and, if it wants to be safe, it asks for some additional amount. A negotiation process then ensues between the CED and the enterprise on the threshold amount, perhaps taking into account the enterprise's feasible technology based on what is already in existence. Since CED's do not have a clear

[33] The enterprises must pay its pollution charges on the 25th of the month following the end of the quarter. If the payment is less than 100 kroons then the enterprise does not have to pay immediately. It can wait until its charges plus any late interest increase to 100 kroons. If the enterprise has not paid late charges within three months, and the amount plus interest is over 100 kroons, the CED can take the case to the civil county court (or administrative court). This threshold amount for possible court action should probably be substantially increased, say to at least 1000 and perhaps 5000 kroons (about 75 USD to 350 USD) to save the court's, the inspectors', and the CED's time to focus on the more important cases.

methodology for determining permitted levels, concern over how stringent permits will stand up in court have been expressed.[34]

One by product of this "lack" of threshold guidance, is that the CED's are free to negotiate a compliance schedule with the enterprise, where the permit can be written in a way to give the enterprise time to adjust to tighter threshold levels in the future. This compliance schedule can be built into the schedule of permit applications and renewal over time. By doing so, the CED can fix clear expectations about future threshold levels while giving the enterprise time to adjust its management and production processes to reduce pollution.[35] Greater use should probably be made of the flexibility to negotiate a compliance schedule within the existing permit structure.

The policy established in December of 1994 making HELCOM effluent standards Estonian policy changes will change this situation to a large degree in the future. New enterprises and repairs on existing enterprises must meet HELCOM standards now while all polluters must meet HELCOM standards in the future (1997 or 2010) depending on quantity of total water discharge.

For both air and water, threshold levels are defined for each point source separately, and threshold levels are defined quarterly for water and annually for air and solid waste. Thus, for example, a plant may have several stacks all the same height and within a very small area, so a permit is established for each stack. Without need for any further discussion, permits should be established for each plant/enterprise/production facility, which creates essentially a within plant bubble policy. Switching from individual point sources (one stack, one water pipe) should probably be allowed for at least two reasons: (1) it makes environmental and economic sense; and (2) it reduces the amount of permits and saves the CED time. Some parties involved in pollution permits already understand these issues and say they are implementing informally this idea of a bubble policy for multiple air stacks for one site.

IV. Issues Related to Implementation of Pollution Policy

It is well recognized in Estonia that current implementation of pollution control policy is not as effective as it could be, although views on the subject do vary from "everything is all right" to "permits are not in place at all". The reality is somewhere in between. It would be perhaps too easy to say throw the system out, and start over. But this is not a correct or appropriate response. The laws and regulations were just approved, time is needed to work out any problems, and it is unlikely the government or parliament would want to redo such policies. Similarly, any wholesale changes would lead to substantial uncertainty for everyone involved that would not lead to a better outcome than already exists. Instead, it makes sense to understand where and how the

[34] Based on our discussions with county authorities, they seem more concerned with reducing the levels of pollution than in collecting large payments. Economic concerns of the enterprise are often taken into account. The system is flexible and gives a lot of discretion and power to the County Environmental Authorities.

[35] Similar to water and air, there is no real policy statement towards solid waste.

existing system needs to be improved, and what modest changes can and need to be made first to improve this pollution policy both as written on paper and as implemented and enforced on the ground. For the longer term, it is clear that Estonia seeks integration with the European Union, which will imply closer eventual harmonization of Estonian environmental policy with European Union policy.

Based on our review, there are at least five key issues that need to be addressed now in Estonia to improve implementation and effectiveness of its policy control policy.[36] These five issues are all important for improving the performance of Estonian policy, where performance is defined as achieving environmental quality goals for lower cost and less uncertainty to business and government (e.g., County Environment Departments and Ministry of Environment).

Issue 1. *What should the threshold levels of pollution be in the permits*?

A first main difficulty for implementing Estonian policy is that there are no clear environmental policy goals specified in the law or regulations. Without this policy goal identified, perhaps some form of ambient environmental quality goals, it is almost impossible to determine if threshold levels in individual permits and the total of permits in any region are reasonable. Similarly, there is no clear Estonian policy that focuses directly on what threshold levels should be in permits, although HELCOM is working on effluent standards on an industry-by-industry case for HELCOM countries. Exactly how such standards related to Estonian policy is yet to be seen.

There is nothing automatically wrong with not having such national policy goals and giving such discretion to the CEDs. But at the same time, it is clear that in some cases the inspectors, Ministry of Environment, and local populations are not satisfied with some of the levels chosen. The lack of some clear policy probably creates some confusion for investors in new enterprises, whether foreign or domestic, since they are not able to predict clearly their current and future pollution control responsibilities.

It is likely that some form of ambient air and surface water quality goals would guide the selection of emission threshold levels, even if emission standards were decided to be unnecessary. Such ambient goals, whether national or regional, would provide an objective indicator as to whether environmental goals were being met. While some form of ambient standards exist for air, they should probably be reviewed and perhaps some of the more common pollutants (see Table 2) could be adjusted. Nothing exists for surface water, and perhaps some easily identifiable indicator of surface water quality, such as dissolved oxygen, would be adequate.

[36]Many other issues were brought up in our discussions with ministry staff, state inspectors, county staff, and enterprises, but we think these issues are the best place to begin.

Issue 2. *Should all potential polluters be required to have permits?*

There are a few large polluters in Estonia. The data on Estonian pollution generation and pollution taxes parallel the concentrated geographic distribution of heavy industrial production in the country. In sum, a few large, primarily state-owned enterprises in the north east of Estonia account for most of the officially recorded pollution and collected pollution charges in the country. In terms of gross air pollutants, for example, ten enterprises (all in the north east) accounted for 317,800 tons of all types of air pollutants out of the 379,800 total estimated for the country from over 600 point sources (Estonian Environment, 1993: p. 50 and p. 52.). The Ministry of Environment also reports that three main polluters, Baltic Thermal Power Plant in Ida Virumaa, Eesti Thermal Power Plant in Narva, and Nordic Cement in Kunda (Laane Virumaa), accounted for about 155,000 tons of solids (particulate) of the total 189,000 tons for over 600 enterprises reported in 1993.

Not surprisingly then, pollution charges are concentrated as well in the north east of Estonia and among a few large polluters. For example, pollution charges for just 10 enterprises accounted for about 95 percent of all air emission charges (about 3.2 million EEK), while waste charges for 5 enterprises accounted for about 90 percent of all solid waste charges in 1993 (about 4.4 million EEK) in 1993 (based on data complied by the Environmental Information Centre).

So, given the concentration of point-source pollution among a few large polluters, one could question the usefulness of creating and enforcing the large number of pollution permits (about 2800 permits total for air, water, and solid waste) that exist currently in Estonia. Unless data show otherwise, there are probably few nets benefits to Estonia of enforcing the permit and charge system for the smaller polluters in terms of costs to the enterprise (monitoring, calculations, studies), costs to the CEDs (administrative, employee work time), and the costs of the small if any reductions in pollution levels as a result of the effort to enforce compliance.

Given the limited resources of the CEDs, perhaps greater use should be made of not requiring a permit for more enterprises. This flexibility did exist regarding water effluent based on the Pollution Charge Act and its regulations, although the impact of the new Water Act seems to have eliminated this flexibility.[37]

Issue 3. *How should monitoring requirements be specified in the permits?*

The current system is based directly on pollutants (emissions, effluent, discharges), although in reality monitoring pollutants directly is not easy for the enterprise or the CED, direct monitoring technology is lacking at many enterprises, and pollutant

[37]Pollution permits for air are required if the emission of a pollutant is equal to or greater than the Minimal Allowed Pollution Quantity for that specific substance (these are listed in the Air Pollutant Standards). In the "Procedures for Issuing Water Permits", when an enterprise is required to apply for a permit is specified, but the necessity of actually issuing a permit is decided by the County Environment Authority. The water permitting procedure gives the option to the Authority as to whether or not to use this tool of pollution permits while air pollution permitting does not currently have this flexibility.

figures are likely to be estimates of varying quality based on technology and inputs. It is virtually impossible to evaluate after the fact the level of pollution. Technically, monitoring water effluent is considered by Estonian officials to be easier and better than for air emissions.

Enterprises are currently required to monitor and measure their own discharges and pollutant concentrations. County Environmental Authorities may also take measurements of enterprises' discharges and register them quarterly. When discrepancies occur, which happens since CED's sampling may occur at different times, days, and locations, then the average is usually taken. Either party has the right to make a formal complaint to the Ministry of Environment, which is supposed to answer within 30 days. But to date, this has never occurred to our knowledge.

Monitoring or measuring the actual pollution amounts remains the key to this entire system of pollution permits and charges. The process currently relies heavily upon self-reporting of enterprises, although it is still the case that an enterprise's pollution permit may not specify exact monitoring procedures (where to test, what time of day, how often, etc.). Enterprises could take their own tests correctly but at a different time in the production cycle from when an Inspector or a County Environmental Authority employee tests, and both tests could yield perfectly legitimate but disparate results. To date, when figures have been different, concern has been expressed over the accuracy of the laboratory which has done the lab work. Margin of errors of tests could also be quite large since some test sampling is still done by hand.[38] At a minimum, the details of exactly how, when, and where monitoring needs to be conducted should be written directly into the permit.

Self-monitoring and self-reporting may also be a tenuous situation in Estonia as in other countries. The enterprise is put in the situation of reporting when it has gone over its threshold levels knowing that this action will result in substantially higher payments, while the penalties for not correctly reporting are not too much higher. Since it is virtually impossible to calculate pollutant amounts after the fact, except for some types of solid waste, it is difficult for the CED to determine whether the enterprise truthfully reported. While the opinion has been expressed by members of the Ministry of Environment that such problems are currently not a problem in Estonia, one only needs to look to the problems of enforcing the Estonian income tax code to find examples where there is not complete compliance with self-reporting requirements.

[38] The USAID (1994) report on Kiviter provides one interesting example of the practical difficulties with monitoring effluent emissions. USAID-sponsored engineers estimated discharge of butyl acetate at about 4 tons per year, a previous group of consultants had estimated discharges at about 12 tons per year, while Kiviter reported about 36 tons of discharge for 1993. This example shows how much variation can occur with estimates of pollution, even if all three calculations are done correctly. The USAID (1994) report mentions briefly why such variations may occur.

Issue 4. *Can the current permit and charge system create incentives for enterprises to control pollution in a least-cost manner?*

Several assumption regarding enterprise behavior and knowledge may not be valid currently for many polluters in Estonia. For a combination permit and charge system to be effective in creating incentives to reduce pollution in a least-cost manner, enterprises must want to maximize profits or at least minimize overall costs, and enterprises must know their costs of reducing pollution. Thus, a prerequisite is a very good accounting system (both technical and financial) in the enterprise. Given that the vast majority of heavy polluters are state-owned enterprises, these assumptions may not be valid.[39] In effect, then, pollution charges are more like a lump-sum transfer from the enterprise (and perhaps eventually the national and local budget) to the Estonian environmental fund.

The least-cost method of pollution control for an enterprise will vary greatly, not only among industries but also among enterprises in the same industry. This type of selection demands specific information on the possible control techniques and their associated costs. Generally enterprises are able to acquire this information when it is in their interest to do so. While it was not in the interest of state industries previously, it is more likely that knowledge of least-costly pollution abatement will be a positive by product of the privatization process in Estonia. It should be emphasized that privatization will not solve all of Estonia's pollution problems, but privatization will help to provide several of the preconditions that are needed for a permitting and charge system to be effective.[40]

Issue 5. *How should economic and environmental uncertainty be incorporated into the permit system?*

There exists substantial economic and environmental uncertainty (variability, fluctuations) at several levels in the system of permits and charges. At the beginning of the permit period, enterprise production, income, and pollution levels are unknown as are future weather patterns. As a result, the enterprise's marginal abatement costs are uncertain as are ambient environmental quality. The value of damages that pollution generates is also currently unknown for many pollutants and areas in Estonia.[41]

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[39] For example, RAS Kiviter is a large state-owned chemical plant that relies on oil shale as a key input. As of 1993, the enterprise says it has no records of what products it sold and how much. Such poor records, if true, would be astounding for a private enterprise. If it does not know what it sold, it cannot know what it produced.

[40] However, with privatization, firm's may have a greater incentive to not report all of their emissions or their costs of the reducing emissions. This does not imply a change for the worse, since state-owned enterprises currently do not even know their emissions or costs of abatement. The self-reporting approach currently used can be adequate as long sufficient incentives are provided in law and regulations to report truthfully. Such incentives do not currently exist.

[41] Even for the highly publicized case of the Kunda cement plant clear estimates of such damages are not available. While the pollutant levels in Kunda are maybe obvious to some, such problems are not so clearly

Thus, returning to Figure 2, uncertainty exists around the three main parts of the figure (pollutant level, marginal abatement costs, and marginal damages). The standard economic approach, under such uncertainty, would be to equate expected marginal benefits with expected marginal costs of abatement. Again, however, to do such calculations it is necessary to have rather sophisticated management capabilities and the probability distributions for the random variables must be specified to some degree. It is hard to argue that such management capabilities already exist within the largest polluters. It is also hard to argue that probability distributions can be reasonably evaluated for the future within the rapidly transforming Estonian economy.

V. FINAL NOTE

Estonian environmental policy will continue to evolve, as it does in all countries, as new information and experience are acquired over time.[42] Using a simple economic framework summarized in Section II, this paper analyzes the basic law and regulations that define in large part Estonian pollution control policy. Several key points of this policy were identified that are important for implementing and enforcing this policy now and in the future, with the intent of achieving pollution policy goals that implies less cost and uncertainty (which is a type of cost) to business and government now and in the future.

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obvious in other parts of Estonia. Cases studies using recent data and systematic evaluation techniques need to be completed in Estonia.

[42] Pollution permits and charges are an important part of this overall policy, but are not and will not be the only set of policy tools used to address environmental concerns. For example, environmental impact assessments and land use regulations (zoning) will play an important role in addressing and managing environmental risks associated with industrial accidents and pollution concerns. A permit and charge approach cannot be easily applied to certain key types of polluters, most notably mobile sources. The Ministry of Environment says it does not currently estimate mobile source emissions (Estonian Environment 1993), but at least some analysis concludes that mobile source emissions are probably substantial in Tallinn (see Reinvald) and probably Narva. The main bus company in Tallinn stands out as an obvious mobile source polluter. Given the large growth in the car fleet and the growing availability of unleaded gasoline, the time is right in Estonia to develop a mobile source emissions policy (including lead).

The purpose of this paper was not to solve Estonian problems. However, several items were identified that are or will be important for current and future policy implementation and enforcement. These items include:

- The strict-liability clause and the pollution charge allowance in the pollution charge law;

- the definition of pollution charges as penalties, the depreciation allowance, and the ability to deduct past losses from current income in the income tax law;

- the possibility that costs of pollution control activities could be exempt from the 18 percent value added tax; and

- the key issues identified in Section IV--threshold levels in permits, exemptions from permits, monitoring requirements, incentives for least-cost pollution control, and economic and environmental uncertainty--that should be addressed to improve implementation and enforcement of the current pollution charge law and regulations.

It is likely that such items will be addressed in the new national environmental policy project, which the Ministry of Environment intends to begin with European Union financial and technical support, as well as the National Environmental Action Program activity that is also in its early stages in Estonia. It is hoped that this analysis of Estonian pollution control policy provide a better foundation of information and analysis for each of these policy activities.

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