

# ASSESSMENT OF GREEN PUBLIC PROCUREMENT AS A POLICY TOOL: COST-EFFICIENCY AND COMPETITION CONSIDERATIONS<sup>♠</sup>

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## ABSTRACT

Public procurement is officially regarded as an effective means to secure environmental improvement. Estimates indicate that public authorities within the European Union typically purchase goods and services corresponding to approximately 16 percent of GNP per annum. Hence, it is believed, private firms can be stimulated to invest in sustainable production technologies if the market power of public bodies is exerted through Green Public Procurement (GPP) policy and legislation. However, GPP has been little studied within a framework of welfare economics. From this perspective we assess GPP as an environmental policy tool and compare it to other tools, such as taxes. The general findings are that it is not clear that GPP can be regarded as a cost-efficient environmental policy tool and that there is a great need for research on the subject in general. This need concerns, besides effects on the environment, especially its effects on market competition. In all, this paper opens up for an interesting and most necessary research area, which is motivated by the importance of resource use for sustainability.

**JEL-classification:** H57, Q01, Q28

**Key words:** Cost effectiveness, Degree of competition, Environmental Policy, Policy tools, Public Procurement Auctions, Sustainability

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## **1. Introduction**

For many countries globally, public procurement represents a significant proportion of the economy. Notably, estimates indicate that public authorities in the European Union (EU) purchase goods and services corresponding to approximately 16 percent of the EU's annual Gross Domestic Product (GDP) (COM, 2008).<sup>1</sup> For a national example, in 2006 the Swedish authorities purchased goods and services totaling between 450 and 535 billion SEK, which corresponds to 15-18 percent of annual GDP (Bergman, 2008). Because of their considerable purchasing power, public authorities are often regarded as having the power to promote sustainable development by stimulating (or demanding) the use of more energy efficient, less polluting production techniques and renewable resources. The purpose of this paper is to assess public procurement standards as a policy tool to encourage sustainable development.

We define public procurement in accordance with the definition given by the Swedish Public Procurement Act (following the EU procurement directives<sup>2</sup>). "Public procurement means the measures implemented by a contracting authority with aim of awarding a contract or concluding a framework agreement regarding products, services, or works."<sup>3</sup> Our analysis only includes public procurement auctions that falls under this definition.

Public procurement, or in the context of sustainability, Green Public Procurement (GPP), is officially regarded as an internationally important, flexible and powerful policy instrument. The European Commission (EC) has emphasized the importance of cost-efficient GPP (COM, 2008) and, in compliance with the EU's Integrated Product Policy (IPC), Member States have been encouraged to devise national action plans. Accordingly, the role that environmental criteria play in procurement has grown in importance, at both national and EU levels. In 2004 the EC published a handbook with the clear aim to help public authorities to implement GPP (SEC, 2004). The EC appears to be very clear in its ambition of how GPP can contribute to sustainability.

However, the credit given *ex ante* to GPP as a viable environmental policy tool has not been thoroughly academically validated. GPP and its impact in terms of both environmental effectiveness and cost-efficiency need to be further analyzed (Lundberg *et al.*, 2008). This need is increased by the fact that the expectations of GPP are typically very high. Many governments and authorities rely heavily upon GPP as an accepted environmental policy instrument (as illustrated by the Swedish Government Bill 2008/09:162).

Within the field of welfare economics, welfare improvement, e.g., due to environmental policy, can also be seen as sustainable development. In this perspective, cost-efficiency and market competition are important factors. Consequently, as GPP is commonly argued to be a cost-efficient way of attending to environmental problems, and as GPP may affect competition (negatively or positively), the assessment of the potential of GPP contributing to sustainable development involves the evaluation of GPP in terms of cost-efficiency and competition. However, in this context, the literature on GPP is limited and as such the current paper contributes to the existing literature.

The major objectives of this paper are to identify and discuss general issues that need to be addressed when considering environmental criteria in public procurement, and the pros and cons of GPP within a framework of welfare economics. Questions particularly addressed are whether GPP is a cost-efficient environmental policy instrument and whether it affects competition in terms of the number of tenders made. We argue that when GPP is implemented its effect on competition must be considered. Environmental gains could be offset by losses in market efficiency due to restriction on competition and, if so, the outcome will not improve welfare and not support sustainable development.

The paper is structured as follows. In the following section the available academic literature is discussed in more detail. Section 3 outlines the institutional settings required for the implementation of GPP together with a discussion of its potential to create incentives for private industry to invest in more environmentally sustainable technologies. In section 4,

GPP and the relationship with other environmental policy tools is discussed in the context of cost-efficiency, goal fulfillment, and spatial issues. The importance of competition and relevant inter-related issues are considered in Section 5. Section 6 concludes the paper and provides a summary and analysis of the benefits and disadvantages of GPP.

## **2. Previous studies**

As an environmental policy tool, GPP as defined in the previous section has been little studied, particularly in the field of economics. Further, authors who have considered GPP have generally treated it as an established policy and either analyzed its effects on specific products and firms' costs (e.g., Marron, 1997; Sterner, 2002; Cerin, 2006; D'Amato, 2006; Parikka-Alhola, 2008; Geng and Doberstein, 2008), or assessed case studies of the practical implementation of GPP (see Thomson and Jackson, 2007, for a UK example or Erdmenger, 2003 for EU examples). None of the cited authors have questioned whether GPP is an adequate environmental policy tool or considered how it should be assessed. Certain other authors have been more prescriptive, arguing that since public authorities have considerable market power, they should implement GPP by making eco-labeling mandatory when formulating environmental procurement criteria (Grolleau *et al.*, 2004). In addition, the wider question of how to make local government budgets greener has been addressed in a book edited by Clinch *et al.* (2002). Here, the concept of making budgets greener covered the role of subsidies as well as public purchasing at local government level. The research was generally descriptive in nature and, once again, the question of whether GPP should be viewed as a complement to, or a substitute for, other types of environmental tools was not highlighted.

Furthermore, in analyzing GPP as an environmental policy tool it is informative but not sufficient merely to report changes in the use of environmental criteria in public procurement contracts (in terms of degree and frequency), which is the approach adopted by Nissinen *et al.* (2009) and Kippo-Edlund *et al.* (2005). Neither of those studies posed the critical

questions regarding the appropriateness of GPP as a welfare-enhancing policy tool, and how to implement it as such.

In addition to the studies of GPP there is also a literature on green auctions including papers covering topics related to this paper. The fact that the social value of the environment may vary from one location to another which is also relevant in the practice of GPP, or that the environment is more or less sensitive to human actions depending on where they take place, is one source to a particular field within the green auction literature (see, e.g., Latacz-Lohmann and Van der Hamsvoort, 1997; Stoneham et al., 2003; Cattaneo et al., 2007). This literature shows that the practice of procurement auctions in allocating nature conservation contracts among landholders offers cost-savings over fixed-price schemes, such as imposing taxes and subsidies. This outcome is based on the presence of asymmetric information. Heterogeneous farmers, facing different costs of conservation actions, know better of their costs (corresponding to the marginal reduction cost curves in Figure 3, see Section 4), and the principal, the procuring government, knows better of the social value of environmental assets on land (corresponding to a social environmental objective,  $z^S$ , in Figure 3 in Section 4). In this setting a procurement auction creates a market for nature conservation contracts where both principal and agents reveal their information, which leads to a more social efficient use of land. Contracts may count for landholders improving biodiversity by, e.g., setting aside land or practicing different management of land, as, e.g., limiting the intensity in use of fertilizers, manure, and pesticides. For further examples of work within this particular field of green auction literature see e.g. Espinola-Arredondo (2008), and Vukina et al. (2008). However, GPP as defined in the introduction does not comprise auctions of tradable permits and conservation contracts. Although of great value and interesting these references are not considered as central for the subsequence of this paper. Here, focus is only on public procurements regulated by the EU procurement directives (or its counterpart in other parts of the world).

### **3. Implementing GPP**

Following EU procurement directives (Directive 2004/17/EC and Directive 2004/18/EC), the inclusion of environmental requirements in public procurement contracts are deemed to be valid as long as they do not discriminate firms from submitting a tender.<sup>4</sup> Briefly, the EU directives stipulate sealed bidding in accordance with the first-price sealed bid auction for public contracts. The bidding process can be regarded as a one-shot game since bidders are not allowed to revise their bids. The winning bidder is in general paid in accordance with her bid.<sup>5</sup> Contracts can subsequently be awarded according to either of two principles. They are awarded either to the supplier who has submitted the lowest price bid or to the supplier considered to have submitted the most economically advantageous bid. When a procuring authority publishes a call for tender it must state the principle that will be applied to evaluate bids. A contract assignment that must conform to the principle of the most economically advantageous bid means that, in addition to price, weight is also given to other criteria such as environmental aspects. The environmental criteria and the mean by which they will be evaluated against other criteria such as quality and price, must be specified in the call for tender.<sup>6</sup> By specifying environmental criteria the procuring authority is enforcing GPP. Under both principles the procedures for bid evaluation and the assignment of contracts are regulated by the directives. If price is the sole factor determining which firm is contracted, the bid is said to be “one dimensional”. If additional criteria are specified when the contracts are assigned, the bids are termed “multidimensional” (see for e.g. Che, 1993 and Asker and Cantillon, 2008). For simplicity, it is assumed here that the bids are two-dimensional, meaning that two criteria are applied; price and environmental aspects.<sup>7</sup> Schematically, the environmental dimension can take the form of eco-labeling, environmental standards, technical standards, material specifications, requirement of specific processes and production methods, and/or performance-based specifications. This means that the environmental criteria may include clauses that oblige bidding firms to change their production technology in order to meet the public procurement requirements. Although the procurement auctions in this paper neither are iterative nor follow the Vickrey-Clarke-Groves mechanism<sup>8</sup>

we follow Parkes and Kalagnanam (2005) and define a utility function of the procuring authority as

$$(1) \quad U = U(p, \theta)$$

Where  $p$  is the price paid to the winner and  $V(\theta)$  is the value of the environmental attributes ( $\theta$ ) to the procuring authority. If the utility function is assumed to be quasi linear and the procuring authority as having to consider a budget ( $B$ ) when maximizing its utility this can be re-written as:

$$(2) \quad U(p, \theta) = V(\theta) + B - p$$

In order to allocate contracts the procuring authority needs some form of scoring rule, which must, as mentioned above, be presented in the call for tender. The procuring directives allow a lot of freedom upon the procuring authority in their design of the scoring rule and it varies a lot in practice (see Bergman and Lundberg, 2009). The exact design of the scoring rule is therefore not discussed in detail but the general principles are described below. The environmental criteria may be mandatory, obliging the firm to demonstrate its ability to satisfy them in order to be considered as a qualified bidder. Such criteria can have varying degrees of stringency. However, environmental criteria may also be recommended, rather than obligatory. Again, in such cases criteria can have varying degrees of stringency. Furthermore, regardless of whether they are mandatory or recommended, consideration can be given to environmental criteria relative to the price of the procured goods or services. This gives the procuring authority an opportunity to tailor its implementation of GPP in several ways, and to decide the relative importance of environmental sustainability and product price. That is, the procuring authority can combine environmental criteria ranging from low to high stringency, with low to high weights attributed to specified criteria. A typical example of a weak criterion would be eco-labeling of some kind, which is generally fulfilled by all firms in a market. As indicated in Table 1, the design of a GPP contract will determine its potential to promote environmental sustainability. Application of weak environmental criteria, in combination with the assignation of low weights to such criteria, will create little or no need for firms to invest in more

environmentally friendly technologies, and as such the criteria will have little or no effect on sustainability.

When the environmental criteria are weighted against price, contracts are assigned according to the most economically advantageous bid. However, using the principle of lowest price does not rule out the option to implement GPP. Procuring entities can specify environmental criteria that are mandatory and award the contract to the lowest bidding firm that can fulfill the criteria. Again the criteria can range from low to high levels of stringency.

[Table 1 about here]

When environmental criteria are selected and formulated by the procuring authority, several factors must be considered to ensure the functioning of GPP. Primarily, the criteria should be adapted to the environmental problems associated with the purchases made to fulfill the GPP contract. In addition, if other environmental policy tools are already in force, such as a tax or fee, then the GPP must complement them. Furthermore, cost-efficiency must be considered when evaluating GPP. Finally, its effect on market competition must also be carefully evaluated. These considerations are discussed in the following sections, starting with cost-efficiency and followed by market-oriented aspects, such as the impact of GPP on competition and the relative importance of the procuring authority in the market.

## 4. GPP and cost efficiency

### 4.1 GPP versus other environmental policy measures

GPP should be considered as an *administrative* environmental policy tool. Administrative tools can be implemented by *command and control* approaches to environmental management, which can include the detailing of the requirements of products, production processes or technologies. All these measures have a common aspect in that they are not usually cost-efficient. More specifically, their implementation does not generally lead to the cost-minimized allocation of resources used to achieve a specified target. In the context of GPP, this could be attributed to the procuring authority having incomplete information about all potential suppliers, their products and production technologies, and also not being aware of all available production technologies. In GPP, command and control style requirements for products, production processes, and technologies are commonplace. Requirements may cite the need, for example, to use a specific technology in the production of a procured product, or to use certain products that do not contain specified hazardous substances when supplying a procured service. However, a major problem in a cost-efficiency perspective of the command and control approach is that it contains no inherent mechanism to ensure that producers who could abate pollution at the lowest cost do so (Perman *et al.*, 1996, p. 223-226). This can be argued to be valid for GPP, as a call for tenders will specify exactly the same environmental requirements for all potential bidders, but of course imposes no restrictions on firms who do not bid.

An alternative approach to environmental control is the use of *economic* tools, such as taxes, subsidies and tradable permits. Taxes and subsidies impact upon emission levels indirectly *via* the price mechanism. Tradable permits work in terms of regulated quantities, similar to the administrative policy tools described above. However, in this case a market is established in which permits may be traded at a certain price and a relative price is established between a permit and a marginal emission reduction. This will create essentially the same economic

incentive to adjust environmentally as in the case of, *e.g.*, a tax (Perman *et al.*, 1996, p. 226-229). As demonstrated in the following section, economic policy tools are automatically cost-efficient, because all producers in the market will adjust until they achieve the same marginal cost of reduction, even though no two producers may be alike.

#### *4.2 Cost-efficiency – What does it mean in the context of GPP?*

The fundamental point of environmental policy is that it should encourage resources to be allocated in such a manner that welfare is maximized. Therefore, economically efficient environmental policy centers on the satisfaction of two conditions (see, *e.g.*, Perman *et al.*, 1996, p. 220). Firstly, given perfect information concerning pollution quantities and their environmental impact, environmental objectives must be optimized. Formally, this entails that a socially optimal objective is achieved when the benefit of additional environmental control balances the cost of implementing this additional control. Secondly, the environmental objectives must be achieved at least cost. If these two efficiency conditions are met, resources, including environmental resources, are allocated in a manner that maximizes welfare. However, it is unrealistic to assume that public bodies will have perfect information (as assumed above), and thus it is unreasonable to assume that they can price environmental resources precisely. Therefore, from a social welfare perspective, it is almost impossible to establish optimal environmental objectives. Instead, desired environmental objectives are established, and the cost-efficiency condition should be the guiding rule in achieving these objectives (Perman *et al.*, 1996, p. 217).<sup>9</sup>

When evaluating GPP as an environmental policy tool, from a welfare and sustainable perspective, it is important to consider cost-efficiency and what this term actually means. In purpose of directing this issue, we first specify initial prerequisites. Assume a society where there is only one producing sector, consisting of only two firms, A and B. The firms are heterogeneous and use different production technologies. This is illustrated in Figure 1.

[Figure 1 about here]

Here,  $P(x)$  denotes the firms' output possibilities sets that represent their technologies. Given these technologies both firms are assumed to emit pollutions corresponding to the amount  $\bar{b}$ .

Before proceeding, leaving the decision to the individual firm, there are a number of ways to reduce pollution (Hanley et al., 2007, p. 132). For instance, firms can install end-of-pipe technologies, e.g., filters. A second option is to change the production process in terms of substituting for environmentally friendlier inputs and/or technologies. Yet another option is simply to reduce production and, therefore, also pollution. Given the initial technologies illustrated in the figure, the marginal costs of reducing the first units pollution are in terms of reduced production,  $y$ , the same for both firms, i.e.,  $MC_A^0 = MC_B^0 = 0$ .<sup>10</sup> However, the marginal cost of reduction will increase at an increasing rate as pollution are reduced. Furthermore, the technology of firm A is environmentally friendlier than that of firm B, i.e., it is always valid that  $y_A/b_A > y_B/b_B$ , for  $y, b > 0$ , which means that the marginal reduction cost will increase at a faster rate for firm A.

Furthermore, from the Baumol and Oates's (1971) "least cost tax theorem", it can be inferred that specified environmental objectives are achieved cost-efficiently when total pollution in society are reduced such that the costs at the margin for reducing pollutions are equal for all polluting sources. In the case of two firms, this is illustrated in Figure 2.

[Figure 2 about here]

As the marginal costs of reducing pollution are increasing at different rates between the firms, the firms' marginal reduction cost curves will differ, i.e.,  $MC_A \neq MC_B$ . Finally, the marginal cost curves of firm A and B sum up to the total marginal reduction cost curve of the society,  $MC^S$ .

Now, assume that the society's desired environmental objective corresponds to a pollution reduction amounting to  $z^S$ , and that the government decides to impose a tax,  $t$ , per unit of pollution, in purpose to meet that objective. As firms are assumed to minimize costs they will all reduce pollution until their cost of reducing the last unit of pollution will coincide with the tax rate. This means that the following condition will be satisfied:

$$(3) \quad MC_A^1 = MC_B^1 = t$$

which is the "least cost tax theorem" by Baumol and Oates (1971).<sup>11</sup> As a consequence of the prerequisites given in Figure 1 (the marginal cost of reduction increasing at a faster rate for firm A) firm A will reduce its level of pollution less than firm B, i.e.,  $z_A^1 < z_B^1$ . Therefore, the tax induces the firms to together reduce pollution quantities at least cost to society, i.e., cost-efficiently. In this particular stylized example the firms' pollution levels will also sum to society's desired level, as we have assumed that the society's marginal cost of reduction curve is known to the tax setting authority and, accordingly:

$$(4) \quad \sum_{i=1}^n z_i = z^S, \text{ where the number of firms is } i = A, B.$$

What about GPP, does it work as a cost-efficient environmental policy tool? The example in Figure 2 illustrates pollution reduction costs given firm technologies illustrated in Figure 1, and cost are measured in terms of necessary reduction of production. However, in perspective of an administrative environmental policy tool, environmental criteria in procurement auction are commonly specified as technical standards, material requirements, and requirements of specific processes and production methods. This means that the requirements to a greater extent aim at directly influencing the firms to change production processes and technologies.

Assume that, instead of pursuing pollution reductions by imposing a tax, the government wants to achieve the society's environmental objective,  $z^S$ , by applying GPP. The environmental criteria are set such that firm A and B must

exchange their technologies for a specified new environmentally friendlier technology; this to be allowed to attend the procurement auction. Notably, as is the practice in procurement auctions, both firms meet exactly the same criteria. In this case the firms have to achieve exactly the same technology standard. Given the initial prerequisites illustrated in Figure 1, that firm A initially produces with an environmentally friendlier technology than firm B does, firm A therefore has to undertake only minor adjustments in order to satisfy the tender's technological requirements, while firm B need to do more. Hence, the adjustment cost is lower for firm A. Consequently, even though the firms meet the same requirements, adjustment costs may differ between firms depending on differing initial technological prerequisites. A slightly softer requirement of technology adjustment would result in adjustment costs for both firms, but with the lowest cost for firm A. Similarly, a slightly more stringent requirement of technology adjustment would result in adjustment costs that are higher, but still with the lowest cost for firm A. Accordingly, there is a relationship between Marginal Cost of Adjustment (MCA) and the reduced amount of pollution, as illustrated in Figure 3.

[Figure 3 about here]

However, even though the two firms produce with different technologies initially, both firms will, ex post the procurement auction criteria, end up with exactly the same production technology. This will lead to firms emitting the same amount of pollution after making the necessary adjustments, and the so-called "green" procurement induced pollution reductions will be the same for both firm A and B, i.e.,  $z_A^1 = z_B^1$ . However, the marginal cost of adjusting from the ex ante procurement technology to the ex post procurement technology will differ between the firms, i.e.  $MCA_A^1 < MCA_B^1$ , which is inconsistent with the Baumol and Oates's (1971) "least cost tax theorem" in equation (3). That is, GPP requiring the same new technology for all initially heterogeneous bidding firms does not necessarily constitute a cost-efficient way of reducing pollution.<sup>12</sup> Referring back to the technology prerequisites in Figure 1, and the cost-efficiency outcome shown by equation (3), the procuring authority should place different

environmental criteria on the attending and initially heterogeneous firms, A and B, in purpose of achieving cost-efficiency and goal fulfillment, i.e.<sup>13</sup>

(5)  $criteria_A \neq criteria_B$

such that

$$MCA_A = MCA_B \text{ and}$$

$$z_A^1 + z_B^1 = z^S$$

If GPP is to work cost-efficiently in practice, in a world of heterogeneous firms, the procuring entities will need to be highly competent in specifying their environmental requirements, and highly aware of the flow and quality of information in society. The simple and stylized example given above indicates that the procuring authority needs to know the differences between every single producer when formulating the call for a public tender. In theory, the public authority needs to know exactly the initial technological prerequisites among its prospective entrepreneurs. An individual firm should perhaps be directed at adjusting to a certain environmental technology standard, and other firms to other individually specified standards. Therefore, exactly the same requirement should not necessarily be imposed on all firms in the tender contract. In practice, this is difficult to accomplish and would most likely result in a call for tender that violates the fundamental principles of the procurement directives, e.g., discrimination. Of course, the cost-efficiency issue is even more complicated if the procurement entity has to consider the complete environmental life cycle (*i.e.*, life cycle analysis) for each product it puts out to public tender, as is often the case in reality.

Finally, if at least one of the potential bidders decides not to participate in the procurement auction, e.g., firm B in the example given above, because it does not expect the benefits of winning the contract to outweigh the costs of adjustment, then the total sum of the bidding firms' pollution reductions will not equal the socially desirable level of reduction. Only firm A will reduce pollution at the amount of  $z_A^1$ , and  $z_A^1 < z^S$ . In this particular case, not only is the implementation of GPP cost-inefficient, it also misses out the environmental objective.

#### 4.3 GPP or economic instruments – Goal-fulfillment or cost-efficiency?

As previously concluded, perfect information is essential for administrative environmental policy tools, such as GPP, to work cost-efficiently. However, the cost of obtaining perfect information is extremely high (infinite) and procuring entities are therefore forced to formulate calls for tenders based on incomplete information.<sup>14</sup> Hence, GPP will never resolve environmental problems cost-efficiently in practice. Furthermore, it is important to note that the cost-efficiency condition should also include related costs, such as for monitoring, administration, and the resources needed to persuade producers to adjust their process technologies to accommodate the requirements of the policy instrument in question. However, the appropriate choice of environmental policy instrument, *e.g.* a tax or GPP, might not always be solely based on cost-efficiency.

Incomplete information will also affect the results of using economic policy instruments, such as an environmental tax on industrial emissions. Since the regulating authorities do not know every producing firm's cost of reduction function, it is difficult to know in advance how large an emission reduction a specific tax rate will lead to (Bamoul and Oates, 1988). This means that a cost-efficient policy tool may be associated with uncertainty, and may therefore be inefficient in terms of goal-fulfillment.<sup>15</sup> If a tax is introduced at too low a rate, then its full environmental objective will not be realized. In response to such an outcome, the tax rate may be increased, but the delay entailed in reaching the appropriate level may result in considerable damage to the environment. In this regard, administrative tools, such as specifying technological requirements, can be more efficient in terms of goal-fulfillment because large emission reductions can be achieved relatively quickly (Perman, 1996, p. 226). This approach is especially valid if 'green' technologies are already available on the market but not yet commonly adopted, and this could be one argument in favor of GPP. Furthermore, there is the possibility of combining administrative and economic environmental policy instruments, *e.g.* environmental taxes and GPP. The selection

of a suitable policy instrument, when dealing with uncertainty is not a trivial issue because the preferred choice will depend on the specific environmental problem and its mitigation costs. As first shown by Weitzman (1974), a useful “rule of thumb” may be that an administrative approach is the best choice if the marginal damage of, for example, pollution rises sharply relative to the marginal abatement cost, whereas a price tool (*e.g.*, a tax) may be preferable if the marginal abatement costs rise sharply relative to the marginal damage.

A further debate regarding administrative versus economic environmental policy instruments concerns dynamic efficiency (Perman *et al.*, 1996, p. 223-226). When private industry adjusts to economic policy tools, for example environmental taxes, it may encourage continued innovative behavior which affects both products and processes. In essence, economic instruments may impose stronger incentives for firms to adopt new cost-reducing technologies than more administrative forms of regulation. A simple reason for this is that a tax (or purchase of permits) not only imposes a pollution abatement cost, but also continues as a tax cost for the emissions which are still released to the environment (see, for instance, Milliman and Prince, 1989, Jung *et al.*, 1996, and Porter and van der Linde, 1995). A hypothesis is therefore proposed that these tools may be considered as continually stimulating technological development and productivity and hence moderating the initial cost increase. Porter and van der Linde (1995) extended this observation by claiming that environmental policy, when designed properly,<sup>16</sup> improves dynamic efficiency to such an extent that it more than offsets the initial cost imposed, and in fact improves competitiveness in the long term. This latter hypothesis known as the ‘Porter hypothesis’ is, however, difficult to confirm empirically (Brännlund and Lundgren, 2009).

However, even though uncertainty and dynamic efficiency, as discussed above, would not influence the choice between an administrative tool as GPP and economic tools, the identification of circumstances that are proper for implementing additional GPP is still a delicate matter. Whether GPP should be implemented, and to what extent, is contingent on the environmental problem(s) that the policy is intended to

address. This decision depends in part on the degree to which the environmental externality associated with the public purchase is internalized (i.e. brought into economic decision-making) by other policy tools. The relationship between GPP and other environmental policy tools is summarized in Table 2, in the three following scenarios. (1) If the environmental externality caused by the production or consumption of the goods being purchased is not internalized, GPP could have a role to play. If all other environmental policy options have been considered and GPP is the best choice it should be implemented. However, it is then important to adapt GPP in such manner that it addresses the relevant environmental objectives. This entails carefully selecting the appropriate environmental criteria, and weights attached to these specifications, to reflect both the externality caused by the purchase and the desired environmental objectives set by the government. (2) If the externality is partly internalized, GPP could play a role that complements the policy tools already in force. Again, GPP must be evaluated relative to other alternative environmental policy tools and optimized to match the required environmental objectives. (3) Finally, if the externality is fully internalized, GPP would do more harm than good from a welfare perspective and should not be implemented. A consequence of the third outcome would be that contracts should only be awarded according to price. That is, bids should be one dimensional, meaning that no environmental criteria should be specified in the call for tender.

[Table 2 about here]

#### *4.4 GPP – a tailoring policy tool beyond the boarder?*

As discussed above, it is not necessarily obvious to choose an environmental tax before GPP if markets are characterized by incomplete information. Furthermore, there are also characteristics of GPP that, under certain circumstances, could be argued to act in its favor. For example, the decentralized decision structure could be advantageous in some cases in comparison to economic tools. An economic tool such as a tax often considers environmental problems at an aggregated level, *i.e.*, everybody in the economy must pay the same tax rate. This means, *inter alia*, that the tax does not take into account the

likelihood that pollution may have effects that vary in significance from one location to another. In such cases, the tax fails to account for the fact that the environment has varying sensitivity to pollutants depending on where the pollution occurs. GPP could serve as an instrument to consider such spatial variations, adjusting to local conditions, and could also account for differences in environmental preferences between local authorities. However, this approach places heavy responsibility on each and every procuring authority to maintain knowledge about the environment and how they interact with it locally. Note also that in this case the procuring authority should not pay attention to common (harmonized) criteria to be used when implementing GPP, e.g. suggested by the EC and national authorities (see, e.g., COM, 2008). Common criteria may put restrictions on the ability of GPP to adjust to local environmental problems that varies between local sites.

Another possible advantage of GPP is that it may be used to reduce pollutions in other countries. Economic tools are typically limited by national boundaries. Taxes, for example, are generally decided at the national level and only target firms located within the nation's geographical borders. GPP, on the other hand, is borderless. Within the EU, for example, public contracts are open for firms in any of the Member States. Hence, if a firm located in country A is interested in submitting a bid in a procurement auction organized in country B, the procuring authority creates incentives for firms located outside the national boundary. Indeed, this option to create incentives for firms to invest in sustainable production technology is not limited by the EU boundaries. However, the power to which this can be realized is contingent on the importance of the procuring authority as a buyer, i.e., the entity must possess significant international market shares.

So far we have discussed different aspects of GPP that are directly connected to GPP as an environmental policy tool. For instance, we have brought to attention that environmental improvements are hardly made cost-efficiently by implementing GPP. However, it is also most important to consider effects of GPP on competition (the number of bidders). If there is a negative effect, e.g., the society suffers a cost that

partly, or fully, offsets the environmental benefit. If so, GPP does not necessarily contribute to increased welfare, or sustainability. The competition issue is discussed in detail in the next section.

## 5. GPP and competition effects

To make the importance of considering the effects of GPP on market competition more evident, it may be asked why engaging in public procurement in the first place? Public authorities could simply provide all their services in-house, rather than through external suppliers. However, by allowing private firms to compete for certain public provision contracts it is maintained that society gains by obtaining better value for money. The basic rationale is that competition stimulates innovation and encourages specialization. It would be very expensive to finance a public sector that was specialized in all areas for which it provided services, and competition in itself leads to lower prices (see Bergman, Nilsson, and Pyddoke, 2005). Therefore, when GPP is implemented its effect on competition must be considered. The argument is that environmental gains could be offset by losses in market efficiency due to restriction on competition. If so, the outcome will not improve welfare and not support sustainable development.

In the auction literature (*e.g.*, Vickrey, 1961; Laffont, 1997) it is well established that bids decrease with increasing numbers of bidders and that too low degree of competition can lead to inefficient outcomes (Bulow and Klemperer; 1996). For simplicity, one can assume a situation in which bids are one dimensional and the contract is awarded according to the lowest price. In such cases, the public procurement process takes the form of a first-price sealed bid auction in which homogenous bidders follow the equilibrium bid function:<sup>17</sup>

$$(6) \quad \beta_i(c) = c_i(\theta) + \frac{\int_0^{\infty} [1 - F(u)]^{n-1} du}{[1 - F(c(\theta))]^{n-1}}$$

$i = 1, \dots, n$  bidders

Here,  $\theta_i(c)$  is the bid placed by bidder  $i$ , which is a function of the actual cost for completing the contract,  $c$ ,<sup>18</sup> and the second term is the mark up, which is monotonically decreasing in  $n$ , the number of bidders.<sup>19</sup> The cost of completing the contract is an increasing function of the environmental attributes of the bid ( $\theta$ ). Differentiation of expression (4) with respect to  $n$  will prove that the more bidders there are, the closer the bid will be to the cost, and the less profit the winning bidder will make. Empirical evidence of this competition effect on bid level is found, for example, in Gupta (2002) and Lundberg (2005). Even if bidders are assumed to be heterogeneous in cost, due to for example difference in production technology, bids are decreasing in  $n$ . From a welfare perspective, the degree of competition is central to a maximizing outcome being reached. The more bidders there are for a tender, the closer the procurement auction will come to realizing the optimal welfare point for society. Therefore, in order to evaluate the total impact of implementing GPP on social welfare, its effect on market competition must be considered.

The enforcement of GPP can be seen to impose an entry restriction upon potential entrepreneurs, thereby limiting competition. If firms are homogeneous in terms of production technology this will result in the procuring authority paying higher prices. In reality, however, production technology is rarely homogeneous among firms. If production technology is assumed to be heterogeneous instead, the effect on the degree of competition will vary. Specifying environmental criteria in public tender contracts could actually restrict entry of some firms but attract others to the procurement auction. For simplicity, it is assumed that there are two types of firms and that an investment in environmentally friendly technology results in increases in costs and thereby in bid prices, see expression (6):

*Type A:* Firms that have invested in environmentally friendly technology. The investment is driven by factors other than GPP being in force.<sup>20</sup>

*Type B:* Firms that have not invested in environmentally friendly technology.

Based on the assumptions made above, type B firms will typically submit lower bids than type A firms, and if GPP is not in practice (bids are one dimensional) they will have a higher probability of winning the contract. Being aware of this situation, type A firms will not participate in the auction. On the other hand, if the procuring authority practices GPP and bids are of a two dimensional nature, type A firms will enter the auction since they know their environmental investments will be valued and therefore have a higher probability of winning. Type B firms face the following decision: to stay out of the procurement auction or make the investment required to meet the environmental criteria. The outcome of that decision will be determined by the expected pay-off from making the investment. If the potential benefits of investment outweigh the costs then type B firms will submit a bid, otherwise they will not. This leads us to three possible scenarios regarding the effect of GPP on the degree of competition:

1. *Positive effect:* The number of Type A firms that enter the procurement auction exceeds the number of Type B firms that exit the market.
2. *Negative effect:* The number of Type B firms that exit the procurement auction exceeds the number of Type A firms that enter it.
3. *No effect:* The positive and negative effects cancel each other out.

Note that the effect on the degree of competition is separate from the effect of price. That is, as a consequence of the assumptions made above (*i.e.*, that meeting the environmental criteria will demand investment which affects costs), in expression (6) the outcome could be that bid prices are higher although more bids may be placed. The ultimate scenario that is observed in reality, *i.e.*, 1, 2, or 3, is entirely market-specific and of an empirical nature.

Overall, the implementation of GPP is revealed as being a complex task associated with important considerations ranging from environmental impact, cost-efficiency, and the degree of market competition to price formation. The following section draws together the main research findings of this paper, and

highlights the advantages and disadvantages of GPP in comparison to economic policy tools.

## **6. Summary and discussion**

In this paper the use and effects of environmental criteria in public procurement, so-called 'Green' Public Procurement (GPP), is considered from the perspective of welfare economics. We focus on public procurements that are regulated by the EU procurement directives (or its counterpart in other parts of the world) and emphasize the absence of research on GPP in this context and assert that it should be made a central area of research. An obvious reason is that within the framework of welfare economics, welfare changes induced by GPP could be interpreted as changes in sustainability. The question is whether GPP causes negative or positive net changes, or whether it causes any changes at all. Crucial aspects are whether GPP, as an environmental policy tool, can be used to reduce pollution problems cost-efficiently, and whether GPP affects market competition (the numbers of tenders made). Both these aspects are connected to the resource use sustainability in society. In this view, the paper provides some stylized facts about GPP, and there are some interesting findings that inspire to future research.

The general finding concerning cost-efficiency is that GPP should not be seen as an alternative environmental policy tool in practice. The reasons are mainly two: Firstly, as firms that participate in procurement auctions are heterogeneous in reality, a cost-efficient environmental policy tool must induce the firms to adjust individually. This means that exactly the same environmental criteria cannot be formulated for every each of the firms. However, firm type tailored criteria are most likely in conflict with the legal principles that govern public procurement, e.g., discrimination. Therefore, the legal principles of GPP counteract the cost-efficiency condition. Secondly, even if firm type tailored criteria would be allowed, the possibility for GPP to work as a cost-efficient environmental policy tool is still negligible in practice. The reason is that due to imperfect information, markets are characterized by uncertainty. Procuring entities cannot gather all necessary and correct information and, therefore, cannot

formulate differing environmental criteria that differ correctly among potential entrepreneurs, such that the condition of cost-efficiency is satisfied. Hence, with the legal aspects of procurement and imperfect information in mind, economic tools such as, e.g., a tax should generally be preferred when the cost-efficiency condition is the only guiding rule. This means that GPP should be considered as an environmental policy tool only when the cost-efficiency condition is not the guiding rule for environmental activities.

The central message concerning GPP and its potential effects on market competition is that it is a research question that is entirely empirical in nature. Theoretically, the enforcement of GPP can be seen to impose an entry restriction upon some potential entrepreneurs, thereby limit the degree of competition, but also to attract some others and thereby increase the degree of competition. Consequently, the net outcome is difficult to establish, and most likely market specific. Furthermore, important to notice is that the degree of competition should be viewed separately from the effect on price. This means that even though the net effect of GPP is increased competition, which have lowering effects on the price, GPP can still lead to a higher price. The reason is that if environmental criteria in procurement are binding the firms are facing adjustment costs when meeting the criteria, which lead to higher unit costs in production and ultimately higher bids. In all, it can be established that there is a lack of research on GPP and topics like cost-efficiency and market competition. Concerning this fact it is surprising that cost-efficiency seems to be commonly appearing as an argument in favor GPP.

In our main discussion concerning cost-efficiency and market competition, we have touched upon some other relevant issues along the way. For example, in purpose of reducing environmental problems, we find that GPP may work as a blunt policy instrument. From the governmental level it is difficult to form an opinion of its full effects on the environment, which makes it difficult to foresee its role in achieving the environmental objectives of the society. One obvious reason is the nature of the multi-dimensional property of the procurement process. In this case environmental criteria are weighted against the price of the procured product, and the contract is assigned

according to the most economically advantageous bid. However, this property will have consequences for the environmental effects. For instance, two separate GPP processes that concern exactly the same product may have quite different effects on the environment as the separate procurement entities may put different weight to the environment relative to the price. At the extreme one of the GPPs may have little or no effect on the environment, and the other a significant positive effect.

Another issue shortly touched upon is that GPP may induce weak incentives to innovative environmental behavior among firms, and there are at least two reasons: Firstly, a tax may encourage continued innovative behavior as it not only imposes pollution abatement costs, but also continues as a tax cost for the pollutions that are still released to the environment. This property does not count for GPP. As once the command-and-control type of environmental criteria, formulated in the call for tenders, are met by the firms, there is no further incentive to adopt an even more environmentally friendlier technology. Secondly, firms can always choose not to adjust to environmental criteria in GPP by not participating in the auction process. Consequently, there is no need for innovative environmental behavior. In this case, the procuring authority's position on the market is of importance. If the entity has a non-significant position on the market, there are likely firms that choose to not participate in the procurement auction. The value of the contract auctioned is too low relative to the cost of adjusting to technological specifications formulated as environmental criteria in the call for tenders. This is to be compared to a tax that will affect all firms, and as such cannot be avoided. Obviously, the option of not entering the procurement auction will also weaken the potential of GPP actually having positive effects on the environment.

Are there any upsides of GPP to be found? Yes, there could be. However, this does not necessarily mean that the total effect of GPP in society contributes significantly to welfare improvement and sustainable development. This is a question of further research, not the least empirically. However, it is earlier argued that GPP should be considered as an environmental policy tool only when the cost-efficiency

condition is not the guiding rule for environmental activities. One of the reasons for GPP not working cost-efficiently is that markets are characterized by imperfect information. However, imperfect information will also generate uncertainty regarding the environmental outcome (goal fulfillment) of using economic environmental policy tools. Therefore, there might be some circumstances where GPP is preferred to, e.g., a tax. However, the selection of a suitable environmental policy instrument, when dealing with uncertainty, is not a trivial issue because the preferred choice will depend on the specific environmental problem and its mitigating costs.

There are also some other relevant issues related to spatial considerations. Firstly, the decentralized structure of performing environmental policy through GPP manifests itself in civil servants working in local public authorities that organize and implement GPP. Therefore, GPP could serve as a measure to account for spatial variations in environmental problems. However, this requires the assumption that every procuring authority has to maintain knowledge about the local environment, how they interact with it, and that they actually formulates environmental criteria that reflects this knowledge. Secondly, GPP could be used to reduce pollution in other countries. However, this calls for the assumption that the procuring authority has a significant position on the market.

Finally, the main conclusion of this paper is that pursuing environmental policies via the implementation of GPP is a complex task. Although GPP is politically appealing as a policy measure and perhaps have some advantages under certain circumstances, there is probably in most cases better to use economic tools, such as taxes, subsidies, and emission permits to deal with environmental problems. However, at present it is difficult to exactly identify circumstances under which GPP may be preferred before economic policy tools, and to what extent GPP then should be used. There is really no existing research that can give guidance within a framework of welfare economics. All we know is that GPP should not be used when the cost-efficiency condition is the only guiding rule for environmental activities. Additionally, if circumstances in favor of GPP can be identified it is still needed to account for the effects of GPP on market competition. Again, there is no

existing research that can give guidance. Hence, in all, the assessment provided in this paper opens up for an interesting and most important research area.

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<sup>1</sup> The corresponding figure is 9 percent for the OECD countries during 1990-1997 (average total expenditure minus employee compensation as a percentage of GDP; Marron, 2003).

<sup>2</sup> Directive 2004/17/EC and Directive 2004/18/EC.

<sup>3</sup> This definition does not include auctions of e.g. tradable permits and conservation contracts.

<sup>4</sup> The EU directives stipulate five principles to be followed by procuring entities. These are the principles of mutual recognition, proportionality, transparency, equal treatment, and non-discrimination. The common denominator of these principles is that tenders, or their bids, should be assessed under conditions of effective competition.

<sup>5</sup> In some cases (by way of exception) the procuring authority stipulates a price and the bidders compete for the contract in the quality dimension only.

<sup>6</sup> An overview and discussion of different models for evaluating bids according to price and quality criteria is presented by Andersson and Lunander (2004).

<sup>7</sup> In reality several types of criteria related to quality aspects, such as references and competence, can be listed and weighed against price.

<sup>8</sup> In a paper by Parkes and Kalagnanam (2005) the procurement auction is modeled as an iterative multi-attribute auction in which contracts are awarded according to a modified Vickrey-Clarke-Groves mechanism (VCG). Attributes are modeled under linear as well as non-linear assumptions. This paper is interesting since it as in our case has the multi-attribute dimension but there is a clear difference in the rules of the game. The VCG mechanism is not applied and in the procurement auctions studied here one-shot bidding is applied. The VCG mechanism is actually, probably due to its complexity, rarely applied in practice and in a paper by Rothkopf (2007) its practical drawbacks are clearly identified.

<sup>9</sup> Note that this means that cost-efficient environmental policy does not necessarily lead to improved overall social welfare. If the environmental target is set incorrectly the environmental policy measure may not contribute to sustainability even if it is cost-efficient.

<sup>10</sup> It is assumed that there is no environmental policy measure in effect initially.

<sup>11</sup> As Baumol and Oates (1988) put it: "A tax rate set at a level that achieves the desired reduction in the total emission of pollutants will satisfy the necessary conditions for the minimization of the program's cost to society (p. 168)". For an accessible textbook description on the subject see e.g. Hanley et al. (2007, pp. 132).

<sup>12</sup> On the other hand, if we, based on the same example as above, instead assume that all firms are initially homogenous, the outcome will show cost-efficiency. However, this is a pure theoretical reflection. Homogeneous firms are most unlikely in reality. Also, in the example above, the outcome of the procurement auction is that firms end up being homogenous. Consequently, the next procurement auction that raises the technological requirements further will induce cost-efficient pollution reduction. This is,

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however, only an effect of the simple and stylized example given and it should not be interpreted as an outcome in reality.

<sup>13</sup>A misinterpretation of the MCA curves in Figure 3 would be that the initially “cleaner” firm A should reduce emissions more than firm B, to achieve a socially cost-efficient outcome  $MCA_A = MCA_B$ . However, the MCA curves show the firms’ costs of achieving exactly the same new environmentally friendlier technology level, where every each level of emission reduction  $z_A^i = z_B^i$ , is an outcome of a certain new technology  $i$ . Specifying differing requirements for every each potential attending firm would give rise to a completely new set of marginal cost of adjustment curves.

<sup>14</sup> See Carlton and Perloff (2005).

<sup>15</sup> The particular uncertainty referred to does not concern tradable permits, because the number of permits that are distributed among polluting sources represents an environmental target measured as a quantity. However, in this case the uncertainty is associated with the price a permit should be set at.

<sup>16</sup> According to Porter and van der Linde (1995), environmental regulations should include pollution taxes, deposit-refund schemes, and tradable permits.

<sup>17</sup> At equilibrium, each bidder assumes, correctly, that competitors act in accordance with the bidding rules described by the first-price, sealed bid auction. As a consequence, expression (4) is valid for all bidders. See McAfee and McMillan (1987).

<sup>18</sup> Theoretically, the cost,  $c$ , can be thought of as being drawn from a probability distribution with a cumulative distribution function  $F(c)$ , and different assumptions can be made about whether each firm’s costs are independent, common, or linked to the costs of its competitors.

<sup>19</sup> The theoretical principles of the first-price sealed bid auction can, for example, be found in Milgrom (1989, 2004), Klemperer (1999, 2004), Krishna (2002), and Menezes and Monteiro (2005).

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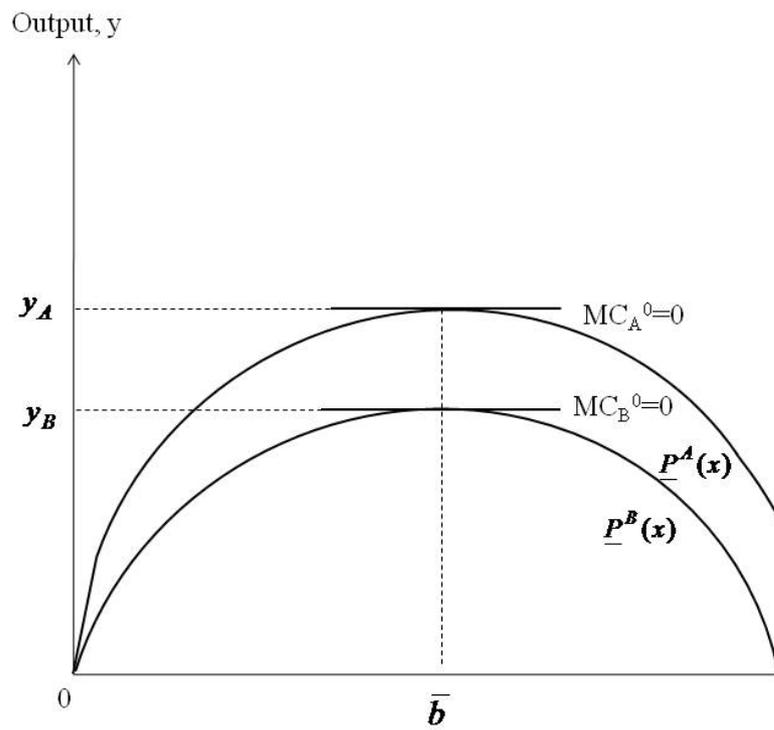
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## Figures

Figure 1. The firms' initial technological prerequisites.



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Figure 2. Cost-efficient pollution reduction when a tax ( $t$ ) is imposed.

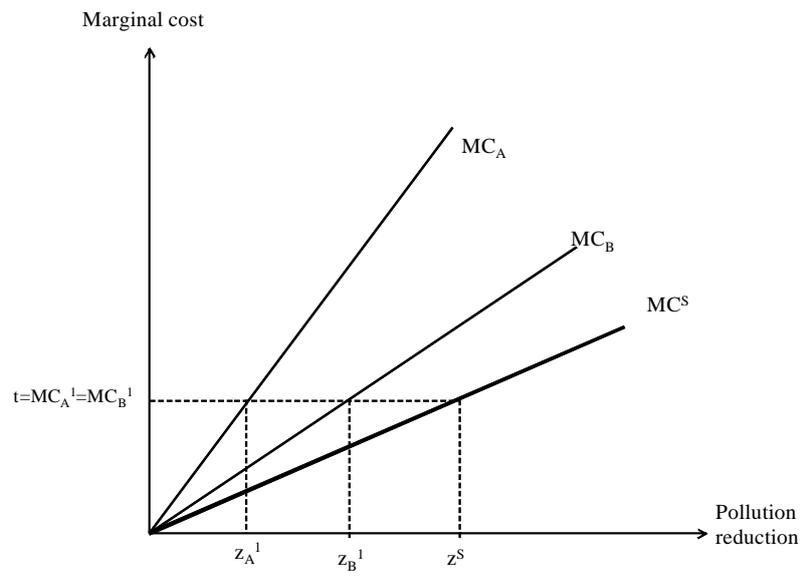
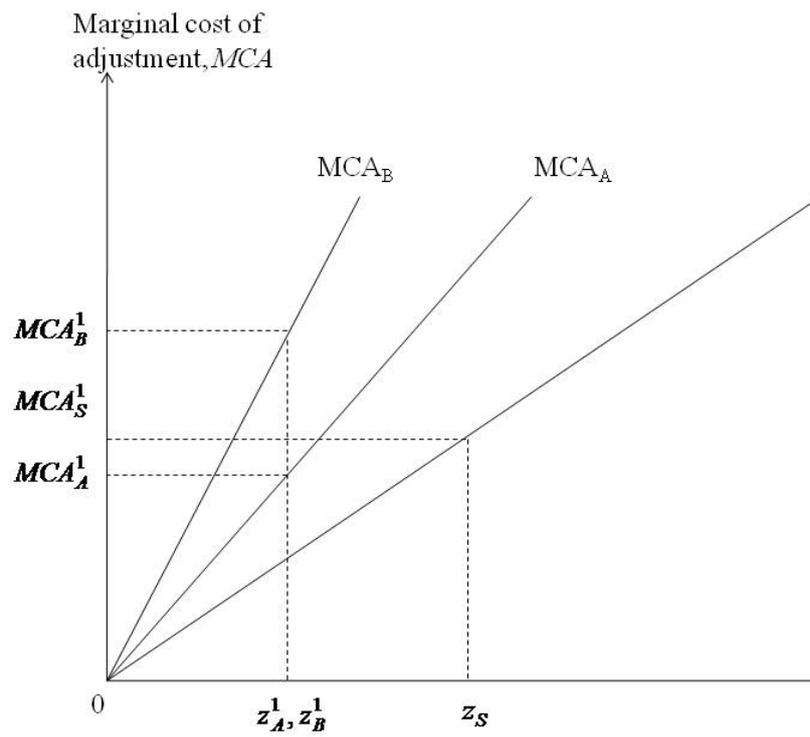


Figure 3. A cost-inefficient outcome of applying GPP.



## Tables

Table 1. The range of GPP outcomes due to different weighting and environmental criteria scenarios

		Environmental criteria	
		Low	High
Weight attached to environmental criteria (relative to price)	Low	(1) None effect on environment	(2) Lower potential effect on environment
	High	(3) Lower potential effect on environment	(4) Higher potential effect on environment

Table 2. GPP – when and to what extent?

Degree to which the environmental problem (externality) that GPP targets is internalized by other environmental policy tools.			
	(1) Not internalized	(2) To some extent internalized	(3) Internalized
GPP	Yes, adapted to relevant environmental quality objectives.	Yes, as in (1), but designed to complement policy tools in force.	No, given optimal and internalized environmental quality objectives this is not justifiable from a welfare perspective.

<sup>20</sup> Note that since type A firms for some other reason but GPP have made the necessary investments in order to fulfill the demanded environmental criteria GPP is not binding as an environmental policy toll. The cost in the bid function specified in expression 6 will for these firms be independent of  $\vartheta$ .