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Is Public Procurement Going Green?

Experiences and Open Issues

Andrea Appolloni¹, Alessio D'Amato² and Cheng Wenjuan³

Abstract:

Public purchasing authorities are in a leading position for the introduction, promotion and development of green procurement. Indeed, the public sector can influence green procurement both by designing suitable policies and by driving “green” markets through the significant share of public purchases on GDP. The European Commission (EC) has emphasized the importance of cost-efficient GPP and, in compliance with the EU’s Integrated Product Policy (IPC), Member States have been encouraged to devise national action plans. As a result, many countries have already adopted steps in the direction of greening public purchases. The aim of our paper is twofold: first, we focus on the state of the art in terms of the EU and Italian Legislation; then, we highlight open questions related to crucial issues in GPP implementation, with a particular attention to the design of green tenders and awarding criteria to account for environmental quality in public purchasing procedures.

Keywords: Green Public Procurement/Purchasing (GPP), Italy, EU, Legislation and Implementation.

1. Introduction

Since the 1992 Conference on Environment and Development of the United Nations in Rio de Janeiro, sustainable development has been considered as a common goal for human being by many countries throughout the world. Green Public Procurement (GPP) has been brought up for its remarkable potential contribution to such a goal. Green Public Procurement/Purchases encompasses all activities that aim to integrate environmental concerns into the purchasing process of public entities, which in turn impacts the product, transport and the whole production chain.

GPP means that purchasing agencies take into account the environmental aspects when purchasing goods and services (Nissinen et al. (2009)). GPP, as a subset of sustainable procurement, is considered as one of the key policies to promote changes of unsustainable consumption and production patterns (Tukker et al., 2008; Clark, 2007; European Commission, 2007).

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Public purchasing is indeed a promising tool to boost the development of green procurement, as public authorities are at the same time responsible of environmental policy design and significant actors in green markets. Under the latter respect, public purchasing accounts for around 16% of the EU's GDP, with much larger shares in specific sectors, such as, for instance, IT, energy-efficient buildings and public transportation. 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 % of annual GDP (Bergman, 2008). GPP development has another striking example in Germany where practical GPP guidelines have existed for almost 20 years (Gunther and Scheibe, 2006).

The European Commission (EC) is encouraging the deployment of cost-efficient GPP (COM 2008/400) 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 authorities play in procurement has grown in importance, at both national and EU levels. Nowadays, many countries, have already adopted (at least preliminary) steps in the direction of greening public purchases (Li and Geiser, 2005). Crucial research questions arise:

1. Is GPP indeed an effective environmental policy rule?
2. How to shape GPP institutions in the broader public procurement setting?
3. How to measure the degree of "greenness" of public procurement?

Starting from these questions we aim to provide food for thought on the design of public procurement and, where possible, to identify the relevance of such questions in the application of GPP by Italian authorities. Our focus cannot be on a comprehensive and detailed analysis of what is green and what is not in Italy. However, we will move a preliminary step in this direction, by summing up some desirable GPP experiences in the EU and in our country and by highlighting some crucial open issues.

2. The legislation status

2.1 At the European Union (EU) level

In 2001, EU published The Green Paper on Integrated Product Policy (IPP) and raised interest towards product-oriented environmental focus (European Commission, 2003).

The aim of IPP is to reduce the environmental impacts of products throughout their life cycle, taking into consideration also the market and competitiveness concerns (European Commission, 2003, p. 6). Increased demand for greener products by GPP, in competition with the more traditional products, is well suited to this market oriented approach of IPP. Environmentally responsible public procurement can also be seen as a driving force in the integration of environmental product policy instruments in the purchasing process (Li and Geiser, 2005). The preparation of new purchase directives in the EU between 2001 and 2004 fostered active debate regarding the possibility to use environmental grounds in public purchasing, and also the Organization for Economic Co-operation and Development provided a recommendation on GPP in 2002 (OECD, 2002), according to which the OECD member countries agreed to improve the environmental performance of public procurement

In 2004, Directives 2004/17 and 2004/18/EC, were approved by the European Parliament and the European Union Council of Ministers, with the aim of simplifying and modernizing procurement procedures, increasing competition and transparency, and explicitly including environmental criteria in the public purchases procedures.

Also relevant to GPP is the publication of the Communication on Public Procurement for a Better Environment (EC Communication COM (2008) 4), which sets out to “...provide guidance on how to reduce the environmental impact caused by public sector consumption and to use GPP to stimulate innovation in environmental technologies, products and services”. Such Communication sets out, in particular, an ambitious (though indicative) target according to which 50% of all public tendering procedures should have been compliant with core EU GPP criteria by 2010.

After such Directives and Communications, the EU renewed the Sustainable Development Strategy in 2006, and in 2008 the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan was published, aiming at improving the energy and environmental performance of products and at increasing the demand for more sustainable goods and production technologies. Along with the EU 2020 strategy, the Action Plan has set specific goals for the GPP in terms, for example, of energy saving and energy efficiency. More generally, the EU legislation on environmentally sustainable consumption and production has evolved rapidly in

the last few years, together with the related (explicit or implicit) obligations for the public sector. Relevant examples include:

- energy end-use efficiency and energy services Directive (2006/32),
- waste Directive (2008/98), explicitly underlying the role played by public purchasing authorities in waste reduction and management
- Directive on the promotion of clean & energy efficient road transport vehicles (2009/33),
- COM(2011)109, setting out an energy efficiency plan explicitly accounting for a key role to be played by public purchasing authorities and with a particular focus in public building restructuring and adoption of sustainability enhanced criteria.

Besides the guidelines, which aim at instructing the practices of GPP, in 2006 Public Procurement Remedies Directives (Directives 89/665/EEC and 92/13/ EEC) have been revised, in order to improve the effectiveness of national review procedures for the award of public contracts. Directive 2007/66/EC provides for rules aiming at obtaining a clear and effective procedure for bidders who consider contracts have been unfairly awarded to seek redress. The Directive gives to the rejected bidders the opportunity to start an effective and timely review procedure, when unfair decisions can still be corrected, and also seeks to combat illegal direct awards of public contracts, considered as the most serious infringement of EU procurement law.

Clearly, a crucial issue in the process of greening public purchases is related to the assessment of what can be considered good or acceptable under a sustainable development perspective, as it is the assessment of the environmental impact of goods or services purchased (Larsen and Svane, 2005). As the EC (2007) suggests, a significant difference arises, for example, in terms of environmental consciousness in public purchases as well as if we focus on how environmental considerations integrate with social and ethical issues. The EC distinguishes between Sustainable Public Procurement, where public purchases take into account environmental as well as social and ethical aspects of sustainable procurement, while under Green Public Procurement contracting authorities "...take into account environmental elements when procuring goods, services or works at all stages of the project and within the entire life-cycle of procured goods".

The appropriate definitions as well as the optimal degree of integration of environmental issues in the more general development strategies of countries and the EU are outside the scope of this paper. We only point out that the stricter the definition, the more difficult is the related implementation. Indeed, the EC (2007) recognizes that sustainable public procurement, though socially desirable, is indeed more difficult to measure and implement with respect to Green Public Procurement. As we recognize Sustainable public purchases as a long term objective, and as greener public purchases are yet in their early stages, we will focus our attention on GPP in the rest of our work.

2.2 Domestic laws and regulations

In Italy, the Public Procurement Code (approved by Legislative Decree April 12, 2006, no. 163, which entered into force on July 1, 2006 - hereinafter referred to as the “Code”) governs public procurement. The Code has put together the previous Italian pieces of legislation on public procurement into one single text. As far as its scope is concerned, the Code covers public works contracts, public supply contracts and public service contracts.

Coherently with the EU legislation, a National Action Plan (NAP) on GPP has been adopted in 2008; such plan is being implemented by an inter-ministerial committee and is being supported by an advisory board, consisting of a body of representatives which includes scientists and stakeholders from all the involved sectors. The NAP establishes 3 main goals for GPP in Italy:

- Efficiency using and saving of natural resources, especially energy;
- Waste reduction;
- Reduction in hazardous substances use.

Also, it requires that at least 30% of goods purchased by public administration shall comply with ecological criteria and at least 30 to 40% shall have reduced electricity consumption. The NAP defines strict core criteria for GPP, leaving however space for adjustment through specific requirements concerning single issues (tenders design, minimum requirements etc.). Subsequent Decrees by the Italian government introduced explicit provisions concerning tender design issues.

Relevant examples under this respect include:

- D.P.R. n. 205/2010: art. 6 amends the Code by introducing art. 180 bis concerning the role of public administrations in promoting initiatives to boost reuse and recycling of waste.
- D.P.R. n. 207/2010: art. 120 introduces the obligation for public purchasers to include environmental criteria in evaluating the most economically advantageous offer (see below)

Other decrees were also approved between 2009 and 2011, to ratify existing EU Directives as well as to regulate specific issues (for example in October 2010 and in February 2011 minimum requirements concerning specific goods and services were introduced).

3. Is GPP an effective environmental policy tool?

A first broad question which is somewhat in the background of our paper is related to the effectiveness of GPP in obtaining environmental policy objectives (energy savings, waste and pollution reduction etc.) As Brannlund et al. (2009) underline, though generally regarded as an effective means to secure environmental improvements, GPP has been little studied within a framework of welfare economics. From this perspective the authors assess GPP as an environmental policy tool and compare it to other tools, such as taxes. Effectiveness and efficiency of environmental policy instruments is the subject of a substantial amount of literature (See, among others, Tietenberg (2009). Brannlund et al. (2009) show that the standard cost effectiveness argument (equalization of marginal costs of environmental care) is likely to be violated by GPP procedures, while other instruments (pollution permits, environmental taxation) are, at least theoretically, capable of achieving an efficient (i.e. least cost) outcome, for a given environmental target. An example in this respect can be based on the uniformity of environmental requirements across potential tender participants. As a result of such uniformity heterogeneities across participants is not exploited and marginal costs are not equalized. Such inefficiency is however somewhat reduced if we focus on awarding criteria: giving the same weight to

environmental performance implies that firms featuring smaller marginal costs of environmental protection will be able to offer, *ceteris paribus*, a better deal, improving the efficiency of the tendering process.

Turning to the impact of GPP on market competition, Brannlund et al. (2009) have underlined that it is a purely empirical question. The net outcome is in fact difficult to establish theoretically, and it is likely to be market specific. Also, the impact on price can be counterintuitive, i.e. a larger competition might be coupled with higher prices, due, for example, to adjustment costs by bidding firms. Reverting again to the environmental requirements example, stricter environmental conditions will imply more or less competition depending on the number and size of firms that gets out of the tendering process (as they do not meet the required standards) or choose to participate (as they are capable of complying with the standards).

Finally, in the reduction of the environmental impact of public purchases the authors show that GPP can be linked in a very weak way to environmental improvements, as procurement procedures are likely to account for such improvements in an “indirect way”.

These considerations suggest that further theoretical and empirical research is needed to investigate the proper role of public procurement in coping with environmental issues. As Walker and Phillips (2006) underline, the majority of sustainable supply research has been conducted in the private sector, though (mainly empirical) literature on the greening of public purchase is growing⁴.

A general conclusion would suggest that GPP is more likely to be an efficient policy choice in sectors where standard environmental policy instruments are difficult to be implemented and/or are in their very early stages. Also, we can expect it to be fruitful when it is introduced in sectors characterized by relatively new technologies (recycling, renewable energy), where the exploitation of economies of scale and scope is necessary to make firms operating in such sectors able to be competitive. On the other hand, we deem as very unlikely the chance for GPP to be an effective policy tool in sectors where public intervention is already well established. Being however the judgment of GPP as an effective and efficient policy tool necessarily based on a case by case analysis, we can conclude that a first open issue arising from our paper is

⁴ For detailed surveys, see the already cited Walker and Phillips (2006) and Brannlund et al. (2009).

related to the need of assessing welfare effects of existing and future GPP practices in Italy.

4. Green Practices in the EU and in Italy

4.1. Good environmental GPP practices in the EU

Several examples of GPP implementation in the EU suggest that a significant effort is being devoted to progress along the GPP pathway.

The EU Commission has published a guidebook in several languages (European Commission, 2004), and national guidebooks have also been published (e.g. in Finland in 2004).

Also, the EC with Communication 400 in 2008 focuses on the removal of obstacles to a full implementation of GPP procedures in the EU. Several hurdles are identified under this respect, including:

- limited established environmental criteria for products / services as well as the absence of publicity mechanisms
- Insufficient information on life cycle costing of products and the relative costs of environmentally friendly products / services.
- Low awareness of the benefits of environmentally friendly products and services.
- Uncertainty about legal possibilities to include environmental criteria in tender documents.
- Lack of political support and resources.

The Communication then sets out objectives, funding as well as core sectors. In targets setting, a major role is acknowledged to several Member States who took the lead in promoting GPP practices. For example, the Dutch government has set a 100% Sustainable Procurement target to be reached by 2010; the Austrian Government has identified ambitious targets to be met by 2010 for relevant sectors, such as IT, electricity and paper. France, has set equivalent, though apparently less ambitious, targets in terms of “clean” vehicles. Finally, the Sustainable Procurement Action Plan in UK aims to reduce Government’s carbon emissions by 30% within 2020.

Significant guidance is provided by the EU. We do not go into details⁵. However, it could be useful to provide additional details on the actual implementation status in the EU as well as exemplify how green criteria are currently integrated into the public procurement procedures (see table 1).

Table 1 - Priority sectors and green Criteria in selected sectors

	Product Group	Product	Core Criteria	Comprehensive Criteria
1	Cleaning products & Services	Cleaning Services (Including cleaning products)	<ul style="list-style-type: none"> • Use of cleaning products without hazardous substances 	<ul style="list-style-type: none"> • Training of employees • Use of reusable microfiber clothing and/or dry –cleaning techniques
2	Construction	New Buildings and offices	<ul style="list-style-type: none"> • Consideration of energy – saving measures in design and usage phase of building • Water- saving technologies in kitchen and sanitary facilities • Use of material without hazardous substances • Use of timber from legal sources 	<ul style="list-style-type: none"> • Use of localization renewable energy sources
3	Electricity	Electricity	<ul style="list-style-type: none"> • 50% or higher electricity from renewable energy sources 	<ul style="list-style-type: none"> • 100% electricity from renewable energy sources
4	Catering & Food	Catering Services (Including Food)	<ul style="list-style-type: none"> • Organic production of food products • Use of seasonal fruit, vegetable and fish 	
5	Gardening	Gardening Services and machinery	<ul style="list-style-type: none"> • Fuel type use of gardening machines • Use of soil improvement without peat and sewage sludge 	
6	Office IT equipment	Computers (desktops & laptop) and monitors	<ul style="list-style-type: none"> • Energy star standards • Accessibility and changeability of memory hard disks and/or CD/DVD drives 	
7	Paper	Copying and graphic paper	<ul style="list-style-type: none"> • Production from recovered paper fibers • Use of ECF/TCF paper • Pulp production from sustainable managed forests for paper based on virgin fibres 	
8	Textiles	Clothing	<ul style="list-style-type: none"> • Oko –Tex Standard 100 	

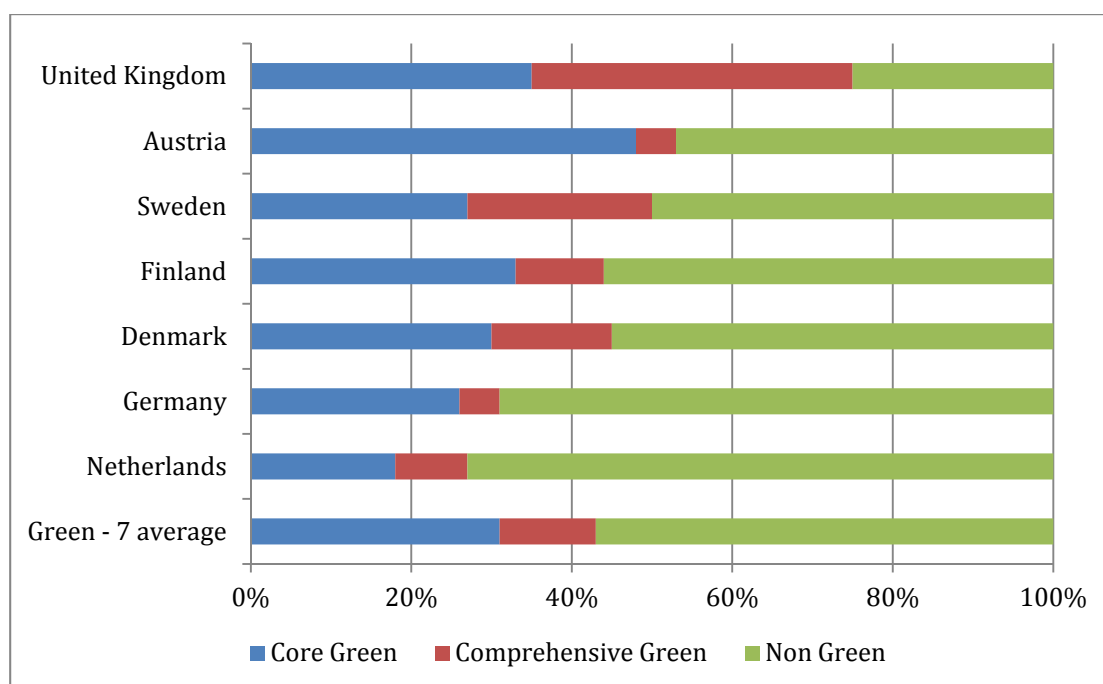
⁵ To have an idea of how extensive EU guidance on GPP is, please refer to: http://ec.europa.eu/environment/gpp/index_en.htm

9	Transport	Passengers cars and light duty vehicles	<ul style="list-style-type: none"> • Maximum CO₂ emission per vehicle segment • Euro 5 standard 	
10	Furniture	Office Furniture	<ul style="list-style-type: none"> • Use of wood from legally sources timber and sustainably managed forests 	

Source - Source: PricewaterhouseCoopers, Significant and Ecofys (2009)

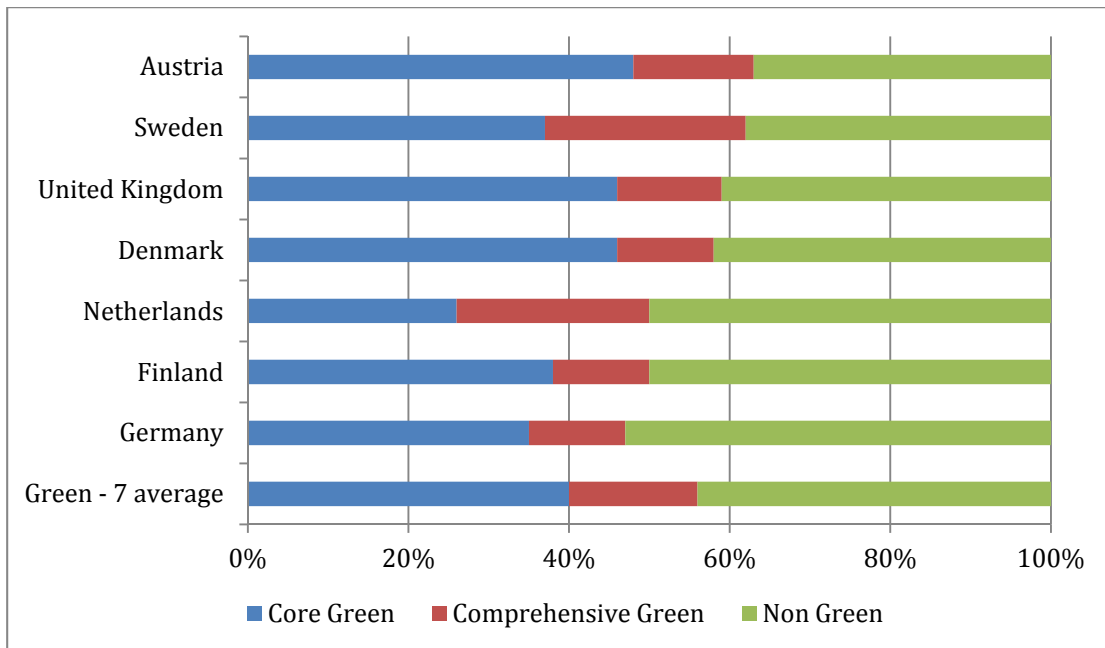
Table 1 sums up core and comprehensive criteria related to a selected set of sectors and green environmental targets. Core targets address the most significant environmental impacts, and are relatively easily verifiable, while comprehensive targets are related to the achievement of more ambitious objectives which require more effort and more difficult verification. Such targets are coherent with the GPP training toolkit developed by the EU.

Figure 1 - Relevance of GPP on total public procurement in terms of value



Source: PricewaterhouseCoopers, Significant and Ecofys (2009)

Figure 2. Relevance of GPP on total public procurement in terms of the number of contracts



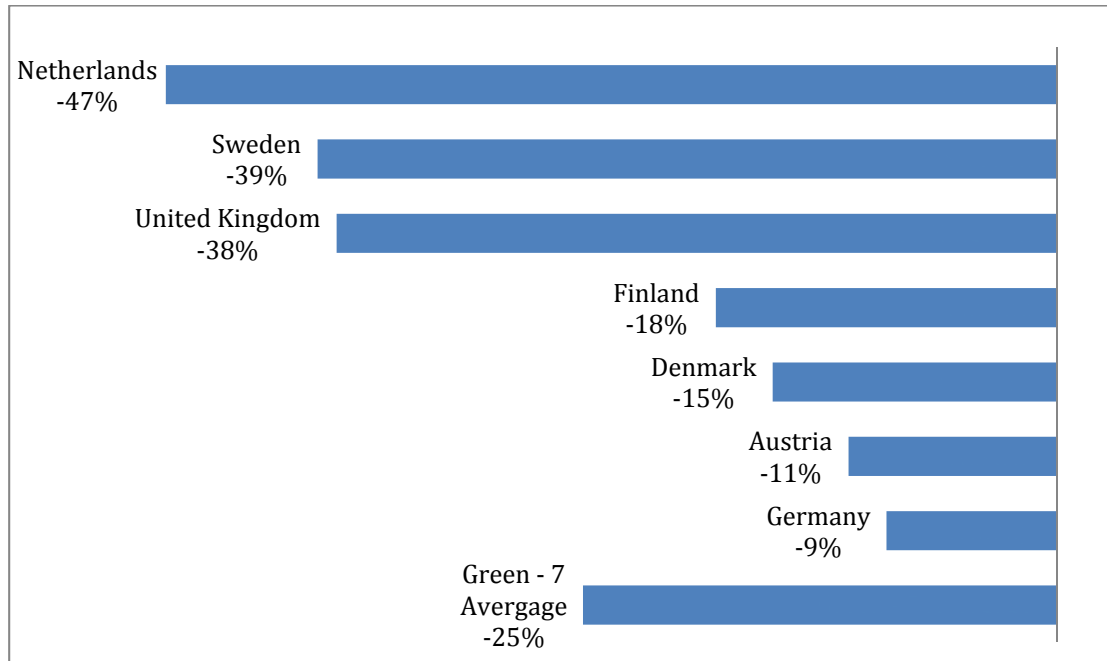
Source: PricewaterhouseCoopers, Significant and Ecofys (2009)

PricewaterhouseCoopers, Significant and Ecofys (2009) provide details on the status of actual implementation of GPP practices in the so called Green-7 countries (Austria, Denmark, Finland, Germany, Netherlands, Sweden and UK). Figures 1 and 2 represent, respectively, the relative relevance of core and comprehensive criteria in terms of value and the number of contracts respectively.

As it clearly emerges, the Green-7 countries feature on average 45% of the total value and 55% of the total number of contracts in 2006/07.

The same report underlines how GPP procedures in the Green-7 have generated significant environmental gains, at least in terms of Co2 emissions, that on average has been reduced by 25% with a maximum of -47% in the Netherlands (figure 3).

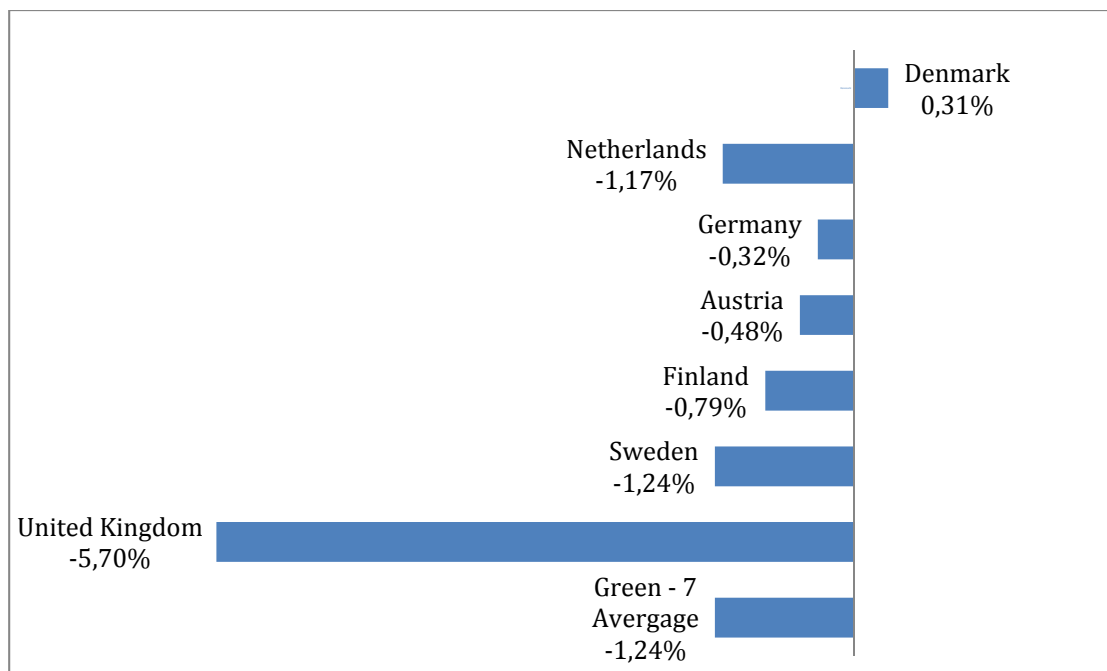
Figure 3 - CO2 impact of GPP per country



Source: PricewaterhouseCoopers, Significant and Ecofys (2009)

Also, we can conclude that the evaluated GPP procedures have been win-win, improvements in several cases, i.e. they also generated significant financial gains in terms of cost reduction.

Figure 4- Financial impact of GPP per country



Source: PricewaterhouseCoopers, Significant and Ecofys (2009)

Finally, PricewaterhouseCoopers, Significant and Ecofys (2009) focuses on the combination of Co2 and financial impact, and conclude that transport, construction and electricity are sectors that deserve attention by the public procurement authorities, as they appear to be the most cost effective in terms of the reduction of environmental impact per Euro spent. Additional, more detailed assessments of the status of GPP implementation in the EU are out of the scope of this paper, and can be found, among others, in AEA (2010), while a detailed analysis of the related costs and benefits can also be found in Öko-Institut e. V. and ICLEI (2007) with reference to years 2006//2007⁶. Also, additional evidence, mainly referred to Nordic countries, will be presented in section 5.3.

4.2 GPP implementation in Italy

As the last section has clarified, GPP brings about significant environmental benefits that might well be coupled with financial gains to contracting authorities. Turning to Italy, legislation has progressed towards a larger implementation of GPP, and several aspects of public purchases are now subject to environment related regulation and incentives. The current status of GPP in Italy appears, however, scattered, with several virtuous cases but compliance and management efforts that appear still weak and lacking a kind of national coordination. As a result, it is difficult to provide a comprehensive idea of the development of GPP in Italy. However, several examples can be provided, to give a flavor of how matters are developing.

Consip S.p.a. is a first significant example; Consip is a public stock company owned by the Italian Ministry of the Economy and Finance (MEF) that operates on behalf of the State, within the framework of the strategic guidelines and tasks given by MEF itself⁷.

Consip has no profit goals and deals with two main fields of action:

1. Consultancy on technical and organizational projects
2. Set up, diffusion and support on eProcurement system and tools

⁶ Also, to have specific examples of GPP in EU countries please refer to: http://ec.europa.eu/environment/gpp/case_en.htm

⁷ See <http://www.eng.consip.it/on-line/en/Home.html>.

Under an environment/sustainability point of view, several specific initiatives have been undertaken over time by Consip, including IT and energy efficiency related projects. Table 3 shows an application of environmental criteria to IT procurement according to Consip strategies. As it clearly emerges, sustainability criteria are accounted for in the whole life cycle of IT machineries, from the design to the production phase, down to the end of life and the management of the related waste.

The estimated environmental impact and costs savings are significant. For example, improved energy efficiency is expected to bring about around € 1,575 Million in terms of costs savings⁸.

Table 2 - Consip approach to GPP in IT public procurement

Design <ul style="list-style-type: none"> • Increase of Energy Efficiency • Cost Reduction • Environmental Impact Reduction 	Production <ul style="list-style-type: none"> • Reduction/Elimination of use of hazardous substances • Decrease if Environmental impacts • Optimization of carriage packaging
<ul style="list-style-type: none"> • Correct energy use management • Information management on environmental impacts • Use of alternative sources of energy Use	<ul style="list-style-type: none"> • Reuse • Recycling • Disassembly of Equipment • Recycling of consuming materials End of Life

Source: Capparelli (2011).

Another example might be found in the framework contract on “Integrated Energy Management Services” (heating services including improvement of energy efficiency, consumption reduction and CO2 emissions avoidance) launched by Consip⁹ in 2006. The tendering process was an open procedure with 12 lots awarded to five different suppliers; the framework was awarded on the basis of the most economically advantageous tender (MEAT), with 70% of marks allocated to price and 30% to quality. Significant effects have been obtained both in terms of cost savings (27%,

⁸ For details see Capparelli (2011).

⁹ For this example, please refer to:

http://ec.europa.eu/environment/gpp/pdf/news_alert/Issue11_Case_Study27_Consip_Energy.pdf

For details on framework contracts see Albano and Sparro (2010)

involving approximately 5,000 buildings) and in terms of energy savings (around 6000 tonnes of oil equivalent).

Several other GPP initiatives have been implemented in Italy. Among others:

- the ARPAT (*Agenzia Regionale per la Protezione Ambientale della Toscana, the Environmental Protection Agency in Tuscany*), where a pilot GPP project for cleaning services for two of its 19 offices was introduced in 2004. Due to the results, in March 2009, the procedure was replicated on a broader scale to encompass all of its offices. The procurement was an open procedure for a three-year contract worth €2.2 Million – 11 bids were submitted.
- the Municipality of Rome, in 2001, begun a program called “Sustainable Food Procurement for School in Rome” in 2001 which aimed to support organic agriculture and organic food chains, and its most recent call for tender for the school food service covers the period September 2007 – June 2012 and has a base value of approximately €355 Million. This program has improved the market in terms of sustainability by procuring organic agriculture products and in turn has reduced the environmental impact of food production and the related activities¹⁰.

All the above pieces of evidence, though not exhaustive, has the merit to show that GPP is increasingly adopted in Italy¹¹. On the other hand, several issues have yet to be addressed.

5. GPP: open issues

5.1. The degree of centralization

5.1.1. GPP and functional centralization

Accord to Martimort (1996), the allocation of jurisdictions across governmental agencies can be analyzed by mean of models dealing with multiple principals in the presence of asymmetric information.

Indeed, government authorities cannot be viewed as a unique body pursuing a common objective but, rather, as a set of entities with different and somewhat

¹⁰ These two examples are, again, taken from http://ec.europa.eu/environment/gpp/case_en.htm

¹¹ For other detailed case studies see, for example, FocusLab (2005).

diverging objectives. Also, the design of regulatory tools must be implemented in the real world, where there are significant informational asymmetries between regulated firms and government bodies.

Under this respect, the example of GPP is straightforward: price reduction and environmental quality of tenders outcomes are competing objectives that might be potentially pursued by competing authorities. It is therefore meaningful to investigate the costs and benefits related to separation of duties among several regulators and/or the integration of functions in a single authority.

Baron (1985) models a regulatory setting close to the US framework, where a Public Utility Commission is interested in welfare of single States' consumers and taxpayers but is also interested in the profit of the regulated firm(s) located in the same State, while a Federal Environmental Protection Agency is interested in welfare effects related to the environmental impact of regulated firms' activity at the whole country (i.e. Federal) level. In Baron's setting an institutional ordering of jurisdictions is assumed, so that the Environmental Protection Agency is capable of free riding on the regulatory design (and costs) imposed at a State level by the Public Utility Commission; as a result, environmental protection is stronger when the two authorities act in an independent way. Opposite results are obtained by Martimort (1996), where no ordering of jurisdictions is introduced: in a hidden information (i.e. adverse selection) context, both regulators design their intervention in order to free ride as much as possible on the capability of the other regulator's contribution to guarantee that a socially desirable project is indeed undertaken, leading to sub-optimal equilibria featuring a lower likelihood that the beneficial project is performed.

D'Amato (2006) extends Martimort in a GPP setting (including also the possibility of moral hazard), where the environmental quality of public purchases changes under two possible institutional settings: a centralized one, where a single regulator is in charge of both production efficiency and environmental quality, and a decentralized one, where two separate bodies operate, namely an environmental agency securing environmental quality and a procurement agency pursuing efficiency. The main conclusions are that decentralization results in a downward distortion in environmental quality as compared to the case of a single integrated authority.

A conclusion stemming from the above papers is, again, that a more applied research is needed. Indeed, the institutional scenario might change across countries and sectors, so that countries like US feature a federal-level EPA and State level public utilities regulation while in other countries such as Italy no such ordering exists. Further, some of the standard for environmental quality in GPP might be set at a EU level while other environmental as well as non-environmental requirements might be set by Italian and other member states government bodies. The assessment of the optimal regulatory setting can therefore be expected to be country and sector specific, and the theoretical analysis presented can be deemed only as a starting point towards a full understanding of the needed steps to achieve the best possible integration of powers in GPP management and design.

5.1.2. GPP and “demand” centralization

Demand centralization/decentralization is another hot issue in the shaping of the Italian Procurement procedures that might have a significant impact in terms of environmental quality. Currently, there is no constraint for public purchasers to act in a cooperative way. As a result, several local bodies might be in charge of public procurement to satisfy local needs.

According to Albano and Sparro (2010), the main economic justification for public purchases centralization can be found in the need to reduce the related costs. It is a fact that several countries feature national (i.e. centralized) procurement agencies (US, UK being two important examples). Cost savings are mainly related to the ability of reducing the buying price as well as to the reduction in transaction costs.

Under the first respect, a major role is played by the possibility to exploit the significant economies of scale that tenders participants are likely to experience due to a larger production level, as well as the increased bargaining power the contracting authority would get by holding a sort of monopsony power.

On the other hand, the reduction in costs might also be related to the achievement of transaction costs reductions related to “optimal” procurement process via specialization, investments in infrastructures (for example e-procurement tools) etc.

The impact of public procurement centralization can be significant also in terms of innovation. Indeed, public procurement might “correct” the market outcome by internalizing positive externalities stemming from innovation, in a kind of “market pull” approach. Such an approach would have the merit of providing firms developing new products and processes with less uncertainty in their potential market, therefore reducing the risk related to R&D related investments. Under this respect, environmental innovations and the reduction in the related risk are an important example. Also, in the presence of network effects, green purchases might boost a “new” and/or environmental market by sustaining a learning by doing process on the demand side. More generally, as already suggested, centralizing public purchases might make it more likely that minimum production scales are reached in innovative sectors.

Another impact of public procurement centralization in innovative sectors is related to the expenses in financing R&D as well as educational programs, which needs substantial budgets to be properly implemented.

Other significant reasons that might affect the way in which GPP translates into a better environmental quality are linked to the degree of positive or negative externalities stemming from public purchases. A first consideration under this respect suggests that a local authority might be willing to internalize pollution damages only to a very limited extent when the pollution problem at hand is of a regional or global nature (such as CO₂), i.e. it mainly generates damages far from the source. This raises significant free riding incentives, leading to too little weight potentially given to environmental quality in the awarding criteria and too weak environmental requirements to access the tendering process.

Another important issue has to do with the time horizon of procurement authorities and to the weight assigned to future benefits and costs (as measured by the discount rate). Consider the example of the functional obsolescence of the objects of a tendering process. A small purchasing authority is very likely not to have the specialized and highly qualified know how that would be needed to account for the proper discount rate to perform a rigorous analysis of the costs and benefits related to obsolescence. Also, we can expect a smaller authority to have a smaller time horizon with respect to a larger authority. This is likely to lead smaller authorities to choose a suboptimal obsolescence and to provide an inefficiently small weight on the duration

of the procured good, leading to a larger than efficient impact on the environment. A straightforward example is related to IT purchases. A too large discount rate (a larger impatience) and a smaller time horizon would lead to buy cheaper computers featuring a quicker obsolescence, implying larger impacts on virgin material as well as a larger waste production.

Of course, procurement centralization also features significant difficulties, including the possibility of larger tenders to exclude smaller firms and, above all, the risk of lock-in related to the repeated nature of the procurement process. Also, a centralized procurement design might imply a lower capability of public purchases authorities to account for local specificities in demand. Costs and benefits must therefore be carefully evaluated. However, the environmental benefits of centralization might be worth the effort in designing procurement procedures in such a way to avoid lock in or “excess scale” problems, for example through the adoption of multiple lots tenders and limits to the number of contracts that can be awarded by each winner¹².

5.2. How to put the environment in public procurement strategies?

According to Piga and Zanza (2004), the design of public procurement involves several steps, including the number of lots, the length of the contract as well as participation requirements and awarding criteria.

We will focus in this section on two crucial parts of the tendering process design in the shaping of GPP procedures, namely requirements and award criteria.

5.2.1. Selection of participants

As Palmujoki et al. (2010) point out, a first possibility for public contracting authorities to include environmental quality in tendering processes is by setting it as a

¹² More details on the available solutions can be found, among others, Lewis and Yildirim (2006) and in Anton and Yao (1989).

prequalification of bidders, as mandatory requirements for the contract, or as contractual terms. Some examples under this respect include¹³:

- the exclusion companies that have acted against environmental legislation or regulations
- the inclusion of green considerations in the technical capacity criteria in terms of the past experience of companies and of the professional qualifications of its personnel
- the inclusion of environmental management systems, such as EMAS, or other Eco-labels, such as the EU Ecolabel, as a means of proof for that technical capacity.

More generally, the selection of participants is an important albeit complex phase of GPP design. Indeed, several difficulties can be identified. First of all, according to EU legislation, mandatory requirements cannot be discriminatory, so that if, for example, the technical specifications imply that the EU Ecolabel is enough to guarantee technical capability, potential participants must be admitted also on the basis of other, equivalent, proofs of the same capability.

The following table represents a good example of “green tenders” design using the EU Ecolabel. As it clearly emerges from the table, the use of an Ecolabel must guarantee that no discrimination takes place among bidders based exclusively on the Ecolabel itself.

¹³ See EC (2010).

Table 3- Using the European Ecolabel in GPP

Using the European Ecolabel in GPP		
	Right	Wrong
<i>Specification</i>	<i>All offered cleaning must meet the ecological criteria of the European Ecolabel</i>	<i>All offered cleaning products must carry the European Ecolabel</i>
<i>Verification</i>	<i>Products carrying the European Ecolabel will be deemed to comply. Any other appropriate means of proof will also be accepted, such as the technical dossier of the manufacturer or a test report from a recognised body</i>	<i>The products must carry a European Ecolabel</i>
<i>Award Criteria</i>	<i>Additional points will be awarded to products that meet the ecological criteria of the European Ecolabel</i>	<i>Additional points will be awarded to the products that carry the European Ecolabel</i>

Source: EC(2008)

Also, important tradeoffs are involved at this stage, the most important being tight requirements vs. competition; for example, stricter technical specifications might imply that potential bidders are excluded from the tender, reducing the number of potential participants and, therefore, the degree of competition. This is why, in some cases, the tendering process can introduce mild environmental prerequisites and choose, instead, to use stricter environmental standards in the awarding criteria. As we have seen in section 4, this has been the case in the design of recent IT tenders held by the Italian public purchasing agency CONSIP

5.2.2. Awarding criteria

Turning to awarding criteria themselves, they are indeed viewed as a crucial step in the design of any public procurement tender, and they can be very fruitfully used to address environmental issues. The existing public procurement Directives clarify that contracts awarding might be based on two main options, i.e.:

- the lowest price
- the most economically advantageous tender (MEAT)

The first one only awards the contract to the bidder that succeeds in making the least costly offer, while in the second case a “scoring rule” can be implemented, including criteria other than the price in the score according to which the contract is awarded.

Clearly, if the environment is an issue, using the lowest price as the only awarding procedure requires the other phases of the tender to be properly designed (for example in terms of technical specifications), while the MEAT implies that bidding can be left open to competition while the environment can be judged in the awarding procedure. On the other hand, the MEAT appears to leave discretionary power in setting the scoring rule, with the risk of not accounting for the environment properly. As a result, there is no one size fits all solution under this respect.

If the environment is included in the awarding criteria according to the MEAT, then the contracting authorities have to set out both the environmental characteristics and their scores in the call for tenders. Such scores must be publicly available and transparent; also, they have to be objectively quantifiable. Though such goals make it clear how difficult setting awarding criteria can be, commonly used procedures exist. Indeed, as the EC (2010) suggests, a widely used methodology is Life Cycle Costing (LCC) , properly including:

- purchase and all associated costs (delivery, installation, commissioning, etc.),
- operating costs, including energy, spares, and maintenance,
- end-of-life costs, such as decommissioning and removal.

The adoption of LCC and, more generally, a Life Cycle approach to GPP can lead to significant costs savings in the public procurement procedures, a higher energy efficiency of buildings and IT equipments being two possible examples.

An evaluation of the relevance of awarding criteria in environmentally related public procurement procedures can be found in Kippo-Edlund et al. (2005). Using data collected in spring 2003, the authors conclude that 58% of the Swedish tender calls included some kind of environmental criteria, but only 36% included environmental award criteria. Environmental aspects were considered also in selection criteria (36% of tender calls), technical specifications (39%), and contract clauses (12%). Another contribution, more focused on the role played by

environmental considerations in MEAT, is the one by Parikka-Alhola et al. (2006); using data collected in the period 21 July – 29 September, 2005 in three Nordic Countries (Denmark, Finland and Sweden), the authors found that the total price of the purchase accounts (on average) for 50% of the awarding scores whereas quality accounts for 37% of the scores. In addition, delivery and contractual terms are worth 7% of scores and environment is weighted on average 3.3% of the scores. This suggests the interesting result that a bidder that accounts properly for environmental criteria can on average charge a price that is 3.3% larger than a bidder that does not achieve good environmental scores. This is a relevant information, as it suggests that some (though limited) gain from making a greener bid can be obtained by firms.

Other examples confirming the tendency of GPP to focus on awarding criteria as one of the tools to provide incentives to environment friendly bids can be found in examples already reported in section 4.2. Having said of the relative weight of energy efficiency in the Consip framework contract on “Integrated Energy Management Services”, it is also interesting to note that in the GPP example related to sustainable food procurement for schools in Rome, the awarding criteria specify that slightly less than half of the score (49 points) was supposed to be assigned according to quality, including environmental criteria. An even clearer example can be found in the copying paper procurement framework contract designed in the Lombardy region in Italy. Award criteria include in this case the possibility to assign 20 technical points to competitors offering¹⁴:

- Paper with FSC, PEFC, Blaue Engel, EU Ecolabel, Nordic Swan or equivalent certification;
- Advance notice of delivery by e-mail;
- Use of a delivery service with green vehicles assessed through random checks on registration documents;
- Use of a delivery service with green pallets (FSC or equivalent certification)

Finally, as clarified in Table 3, it is crucial to underline the need for awarding criteria to be designed in such a way to be non discriminatory. The related considerations made in discussing participants selection also apply here.

¹⁴ See http://ec.europa.eu/environment/gpp/case_en.htm, Example 15.

5.3. Measuring the “greenness” of public procurement: methodologies and further research

The last issue we are willing to address is related to the need to measure whether public procurement is indeed green or sustainable. This is a challenging task for several reasons, mainly related to the difficulties in providing an objective (e.g. monetary) measure for certain kinds of environmental damages, as well as to the complexities related to the need of disentangling green characteristics from “non green” ones. For example, while it is relatively easy to spread the good news about improved energy efficiency and in terms of reduced (estimated) CO₂ emissions, it is not as easy to disseminate evidence concerning reduction in life expectancy and the related social losses.

A somewhat different hurdle lies in the very limited amount of available literature on the topic. More precisely, while several papers address the qualitative impacts and the design of public procurement procedures, very little effort has been devoted to the measurement of the degree of “greenness” of public (as well as private) purchases (Walker and Phillips, 2006). Significant exceptions, however, exist.

The received literature has measured the state of GPP through the use of environmental criteria in tender calls and documents (Bouwer et al., 2005; Kippo-Edlund et al., 2005); most of these contributions are, however, focused on Nordic countries. In a more recent contribution (Palmujoki et al., 2010), the authors focus specifically on the existence and applicability of environmental criteria in the procurement contracts and discuss the comprehensiveness and enforceability of the drafted terms and conditions in the same contracts, highlighting the practices that appear as the most functional and practical from the procuring authorities’ point of view. As the authors show, with reference to Sweden and Finland, the application of GPP is increasing over time. However, the inclusion of environmental clauses in procurement contracts is still not widely used. Also, the clauses vary widely in terms of both accuracy and enforceability by the procurement authorities.

The above literature is mainly based on tender calls analysis. As Bouwer et al. (2005) underline, such analysis is mainly performed by gathering tender related documents along a chosen time span from a variety of public bodies (Local Authorities, Central Government, Hospitals, etc.), and by classifying them according

to product groups and according to the role played by environmental criteria in the tender documents, technical specification, awarding score and criteria etc.

Though objective, such a methodology suffers from several limitations, including:

1. Information contained in the tender document has to be complemented by the actual awarding results (winner, value of purchases etc.).

2. The publication of tenders is compulsory only above a certain tender value (so called “above the EU threshold” tenders). On the other hand, very limited information is available concerning smaller tenders.

3. Information on the purchasing body can be crucial in explaining green behaviour and in directing the related policy interventions. On the other hand, such information is in general not included in the tender and difficult to obtain.

4. The willingness to pay for greener public purchases might not be the only determinant of demand for sustainable goods/services by public bodies. Indeed, EU regulation and targets might affect the observed GPP related demand.

These difficulties suggest the need to complement tender documents analysis with interviews that completes the available information, including details both on the public bodies involved with the specific tender and on the final outcome of the tender itself. An online procedure based on questionnaires has been used, among others, by PricewaterhouseCoopers, Significant and Ecofys (2009), in the report on GPP that was presented in section 4.1. concerning the EU.

Of course, also the use of questionnaires has limitations, as they can lead to a bias in respondent’s reaction (they can state they are willing to pay for green purchases just to show they act in a socially responsible way, or they can give a distorted view of the purchasing organization they work for). Also, it is more likely that a selection bias takes place, as respondents are likely to come from organizations that are already involved, or more willing to be involved, in GPP.

7. Concluding remarks

Green Public Procurement can be (and has proven to be) a potentially very effective tool in the context of environmental policy, leading in some cases to win-win situations where the reduction in environmental impacts of public purchases is coupled with a reduction in the related costs. This is, however, not a general

conclusion, so that the opportunity of introducing GPP targets and incentives must be carefully evaluated with sector and country specific analyses. Also, the performance of GPP depends in a crucial way on how it is designed and, specifically, on the degree of centralization and on the way environmental criteria are accounted for along the “GPP chain”. Under the latter respect, the inclusion of environmental considerations in awarding criteria can play a significant role and is, therefore, a sensitive issue for future research.

The main conclusion that stems from our work suggests the need to improve data availability to make GPP design and implementation more efficient. This is straightforward if we look at the Italian case: the building up of comprehensive data sets might be crucial in determining whether the current system is properly designed or if changes in design are needed, for example in terms of a larger degree of centralization. Also, measuring the degree to which GPP is indeed green and/or sustainable needs a substantial systematization of available information on tender calls, value and features of procurement contracts. This is a key issue to measure the state of the art of GPP implementation in Italy, and to suggest directions for future policies in the field.

References

AEA. (2010). *Assessment and Comparison of National GPP/SPP Criteria and Underlying Schemes*, AEA/ED47517/Issue 6. Online available HTTP <<http://ec.europa.eu/environment/gpp/pdf/Criteria%20and%20Underlying%20Schemes.pdf>>

Albano, G.L. and Sparro, M. (2010) ‘Flexible Strategies for Centralized Public Procurement’, *Review of Economics And Institutions*, 1: Article 4.

Anton, J.J. and Yao, D.A. (1989). ‘Split Awards, Procurement and Innovation’, *Journal of Economics*, 20: 538-552.

Appolloni A., Fiorani G., Guenoun, M. et Tort M. (2010). Best Practices dans les marchés publics écologiques: une comparaison Italie-Suisse et France. *Presented at the “Troisième Dialogue Euro Méditerranéen de Management Publique - MED3: 6-8 Octobre 2010 Tunis – Tunisie*.

Appolloni, A. and Fu, J. (2010). A Literature framework for Green Procurement Management. *Presented at the International Conference “Making Public*

Management Work in the Global Economy: Lessons from Europe and North America” September 23-25, 2010 Central Michigan University USA

Baron, D. (1985). ‘Non-cooperative Regulation of non-localized externality’, *Journal of Economics*, 16: 553-568.

Bartolomeo, M. and Daelli, S.M. (2008). ‘*Acquistare verde: dalla sperimentazione alla creazione di un mercato.*’ Il ruolo delle imprese e delle Pubbliche Amministrazioni italiane. Avanzi Idee ricerche e progetti per la sostenibilità.

Bergman, M. (2008). ‘*Offentliga upphandlingar och offentliga inköp.*’. Konkurrensverket.

Bouwer, M., De Jong, K., Jonk, M., Berman, T., Bersani, R., Lusser, H., Nissinen, A., Parikka, K., and Szuppinger, P. (2005). ‘*Green Public Procurement in Europe 2005 – Status Overview.*’ Online Available HTTP <http://ec.europa.eu/environment/gpp/pdf/report_facts.pdf>

Bouwer, M., Jonk, M., Berman, T., Bersani, R., Lusser, H., Nappa, V., Nissinen, A., Parikka, K., Szuppinger, P. and Viganò, C. (2006): green public procurement in europe 2006 Online Available HTTP <<http://europa.eu.int/comm/environment/gpp>>

Brännlund, R., Lundberg, S. and Marklund P.O. (2009), ‘*Assessment of Green Public Procurement as a Policy Tool: Cost-Efficiency and Competition Considerations*’ (May 8, 2009). Online Available HTTP <<http://ssrn.com/abstract=1831089>>

Brännlund, R., O. Carlén, T. Lundgren and Marklund, P.O. (2009). ‘*Samhällsekonomiska konsekvenser av intensivodling, faktaunderlag till MINT-utredningen*’, *SLU, Rapport*, (in Swedish)

Capparelli, L. (2011). ‘*Consip’s Approach to GPP*’, *presented at the Workshop 4/4/2011 - E-procurement and energy efficient datacenters. Consip - Rome, Italy.*

Gelderman, C. J. Ghijsen, P.W.Th. and Brugman, M. J. (2006). "Public procurement and EU tendering directives – explaining non-compliance", *International Journal of Public Sector Management*, Vol. 19 Iss: 7, pp.702 - 714

Cattaneo, A., Lankoski, J. and Ollikainen, M. (2007). ‘*Green Auctions with Joint Environmental Benefits*’. Discussion papers, 19, *Department of Economics and Management, University of Helsinki*

COM (2008). ‘*Public Procurement for a Better Environment, Communication from the Commission to the European Parliament*’, The European Economic and Social Committee and the Committee of the Regions, COM (2008) 400.

Clark, G. (2007). Evolution of the global sustainable consumption and production policy and the United Nations Environment programme’s (UNEP) supporting activities. *Journal of Cleaner Production* 15, 492-298.

D'Amato, A. (2006). 'Environmental Issues in Public Procurement: How Much Decentralization?', *Rivista di Politica Economica* 96 (1-2): 209-234

European Commission, (2004). *Buying Green! A Handbook on Environmental Public Procurement*. Online Available HTTP
<http://ec.europa.eu/environment/gpp/pdf/buying_green_handbook_en.pdf>

European Commission, (2007). *Background Document to the Consultation on the Action Plans on Sustainable Consumption and Production and Sustainable Industrial Policy*. Online Available HTTP <<http://ec.europa.eu/enterprise/environment/sip.pdf>>

European Commission, (2007). *GPP- How Green is your Public Procurement?* Online Available HTTP <http://ec.europa.eu/environment/gpp/green_vs_sustainable.htm>

European Commission, (2008). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan*. COM(2008) 397/3. Online Available HTTP http://ec.europa.eu/environment/eussd/pdf/com_2008_397.pdf

Geng, Y. and Doberstein, B. (2008). 'Greening Government Procurement in Developing Countries: Building Capacity in China.' *Journal of Environmental Management*, 88: 932-938

Gunther, E. and Scheibe, L. (2006). 'The hurdle analysis. A self-evaluation tool for municipalities to identify, analyse and overcome hurdles to green procurement', *Corporate Social Responsibility and Environmental Management*, 13: 61-77.

Kippo-Edlund P., Hauta-Heikkilä H., Miettinen H., and Nissinen, A. (2005). 'Measuring the Environmental Soundness of Public Procurement in Nordic Countries.' *Tema Nord* 2005:505, Nordic Council of Ministers, Copenhagen. Online Available HTTP <www.norden.org/pub/miljo/miljo/sk/TN2005505.asp>

Larsen, K. and Svane, Ö. (2005). 'Routines and communities of practice in public environmental procurement processes' *CESIS Electronic Working paper Series*, Paper 44.

Lewis T.R., and Yildirim H. (eds) (2006). *Managing Dynamic Procurement*. In N., Dimitri, G., Piga, and Spagnolo, G., *Handbook of Procurement* (pp. 433-445), Cambridge, UK: Cambridge University Press

Li, L. and Geiser, K. (2005). 'Environmentally responsible public procurement (ERPP) and its implications for integrated product policy' (IPP). *Journal of Cleaner Production*, 13: 705-715

Martimort D. (1996). 'The Multiprincipal Nature of the Government', *European Economic Review*, 40. 673-685.

Ministero dell'ambiente e della Tutela del Territorio (2006), "Acquisti verdi per la Pubblica Amministrazione: stato dell'arte, evoluzione normativa e indicazioni metodologiche", Settembre 2006

Ministero dell'ambiente e della Tutela del Territorio (2007). "Piano d'azione per la sostenibilità ambientale dei consumi della pubblica amministrazione"

Mogens, P.C. (2006). The power of green procurement. Online Available HTTP <http://ec.europa.eu/environment/gpp/pdf/green_procurement.>

Nissinen, A., Parikka, K. and Szuppinger, P. (2005) 'Green Public Procurement in Europe 2005 — Status overview',. *Virage Milieu & Management, Netherlands*

Nissinen, A., Parikka-Alhola, K., and Rita, H. (2009). 'Environmental criteria in the public purchases above the EU threshold values by three Nordic countries: 2003 and 2005'. *Ecological Economics*. 68: 1838 – 1849

OECD (2002). *Recommendation of the council on improving the environmental performance of public procurement*. OECD Act C (2002) 3. Paris, France.

Öko-Institut E.V. and ICLEI (2007) . 'Costs and Benefits of Green Public Procurement in Europe'. Online available HTTP <http://ec.europa.eu/environment/gpp/studies_en.htm>

Palmujoki, A., Parikka-Alhola, K. and Ekroos, A. (2010). 'Green Public Procurement: Analysis on the Use of Environmental Criteria in Contracts', *Review of European Community & International Environmental Law*, 19: 250-262

Parikka-Alhola, K. (2008). 'Promoting environmentally sound furniture by green public procurement.' *Ecological Economics* 68. 472 – 485

Parikka-Alhola, K., Nissinen, A. and Ekroos, A. (2006). 'Green award criteria in the most economically advantageous tender in public purchasing'. In: Thai, K.V., Piga, G. (eds.), *Advancing public procurement*, PrAcademics Press, Boca Raton, USA; 257–279.

Piga, G. and Zanza, M., (2004). 'An exploratory analysis of public procurement practices in Europe', *Quaderni Consip*, 3.

PricewaterhouseCoopers, Significant and Ecofys (2009). '*Collection of statistical information on Green Public Procurement in the EU*', Online available HTTP <http://ec.europa.eu/environment/gpp/pdf/statistical_information.pdf>

Sancassiani, W. and Lembo, G. (2005). 'Esperienze di Green Procurement negli Enti Locali', *FocusLab Report*, October 2005.

Sterner, E. (2002). 'Green Procurement of Buildings: A Study of Swedish Clients' Considerations.', *Construction Management and Economics* 20; 21-20

Stoneham, G., Chaudhri, V., Ha, A., and Strappazon, L. (2003). 'Auctions for Conservation Contracts: An Empirical Examination of Victoria's Bush Tender Trial.' *Australian Journal of Agricultural and Resource Economics* 47: 477-500

Tietenberg, T. (2009). *Environmental and Natural Resource Economics*, Prentice Hall, 8th edition

Walker, H. and Phillips, W. (2006). 'Sustainable Procurement: Emerging Issues', *International Public Procurement Conference Proceedings*, September 2006

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