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GREEN PUBLIC PROCUREMENT FOR A SUSTAINABLE PUBLIC ADMINISTRATION IN A RESILIENCE CONTEXT

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Abstract

Green Public Procurement is the approach adopted by Public Administration (PA) that integrate application of environmental criteria and technologies along entire life cycle of the ecological purchasing process. It is a voluntary instrument within the Europe but mandatory in Italy in accordance with article 34 of Law Decree 50/2016 and the new Public Contract Code. Subsequently, in the GPP was integrated the Action Plan for the environmental sustainability of public administration consumption in 2008 which defines national objectives, categories of goods and services, defines the Minimum Environmental Criteria (MEC) and provides guidelines for PA, with the aim of promoting the adoption of the GPP. Moreover, within European member state, the Italian Public Contract Code provides for compliance with public procedures only in the case that such contracts are strictly functional to the core business. The aim of this review is to analyze the difficulties that currently limit the application of GPP especially in Italy, strictly connected to the special sectors of the PA. The authors carried out an analysis of the evolution path of GPP and of the possible solutions that can be adopted to support the integration in the public administration. The result underlined that an important limitation concerns business of public administrations operating in special sectors such as gas, thermal energy, electricity, water, transport, postal services, exploitation of geographical area.

Key words: benefits, green public procurement, Italy, obstacles, public administration

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1. Introduction

Since the International Conference on Environment and Development hosted in Rio de Janeiro in 1992, the importance of Green Public Procurement (GPP) in supporting sustainable consumption and production models has been underlined. Nowadays, this awareness has greatly increased and disseminating through public authorities and public administrations (PAs), both as a political and technical tool in the planning of interventions and contracts (Testa et al., 2012a).

In the context of sustainability issues, PAs plays a crucial role: they have a high purchasing power, and the procurement market has enormous potential with positive repercussions on the economies of the countries. In 2018, EU PAs consumed around

670.31 billion euros, 22% more than in 2017 and about 29% more than in 2016 (European Commission, 2021). Additionally, in the same year, Italy invested 168 billion of euros, 36% more than 2016 (ANAC, 2022).

However, consumers and users play an important role by in public procurement context. Therefore, given that public procurement influences production and consumption trends, even a significant demand by public administrations for "greener" and environmentally friendly goods and services will expand the markets for such products and services (Li and Geiser, 2005).

Therefore, PAs must be ready to face the challenges of changes in consumption preferences and in parallel of climate change and socio-economic disparities (Rodriguez-Plesa et al., 2022). For this

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reason, local governments are slowly incorporating sustainability principles into their policies, as highlighted by Laurian and Crawford (2016). The approach towards the green and sustainability of the PAs has also been documented in the evolution of public procurement, translated into green public procurement (GPP) and sustainable (public procurement SPP), both public procurement practices (Alkadry et al. 2019).

Generally, the key role of GPPs in the economy and sustainable development is highlighted because the effects produced by their adoption fall on environment and companies that are identified in the procurement procedures and on PAs (Fig. 1).

Particularly, as shown in Fig. 1, in the basic framework the production and consumption patterns - in the public and private sectors - changed substantially over the past decades (Hermundsdottir and Aspelund, 2021), leading to social and environmental transformations and creating demands, constraints, new approaches and limitations for the companies. Furthermore, the key element driving this interconnected transformation is the management of innovation and sustainability (Annesi et al., 2023). Among these effects, the authors highlighted:

- a) reduction of environmental impacts,
- b) protection and improvement of the competitiveness of businesses, incentive for innovation, rationalization of public spending, diffusion of sustainable consumption and purchasing models, efficiency and saving of natural resources,
- c) reduction of waste produced,
- d) reduction in the use of hazardous substances,
- e) integration of environmental considerations into the other policies of the institution, improvement of the image of the public administration,
- f) enhancing the skills of public buyers.

Particularly, at national level, In Italy, GPP is playing a key role in public procurement considering the investment of the National Recovery and Resilience Plan (NRRP). As a matter of fact, this Plan provides that public administrations must adopt the DNSH (Do No Significant Harm) principle as a preparatory element for any funding from public or private entities, i.e. not causing significant damage to the environment. This procedure is accelerating and increasing GPP adoption procedures. Hence, the DNSH approach requires the mandatory adoption of Minimum Environmental Criteria (CAM). Furthermore, for 37% of the resources of the NRRP equal to approximately 200 billion euros, it will not be possible to limit oneself to “*not causing significant damage to the environment*” but must be shown to have contributed substantially to environmental improvement. Therefore, at the Italian level the implementation of NRR and GPP will be parallel (Falocco et al., 2022). Moreover, this direction in public procurement procedures has, however, led to some studies conducted over the years (Table 1). Amongst these studies, several empirical applications shown that public procurement can be a relevant innovation policy on the demand side (Castelnovo et al., 2023).

This review aims to analyze the difficulties that currently limit the application of GPP strictly connected to the public administration, in particularly in Italy, a European member state. The methodology consists in a review of the evolution path of GPP and of the possible solutions that can be adopted to support the integration in the public administration. Particularly, the novelty of this study relies in the analysis of the elements that facilitate or obstruct the adoption of the GPP under the NRRP which is involving Italy currently.

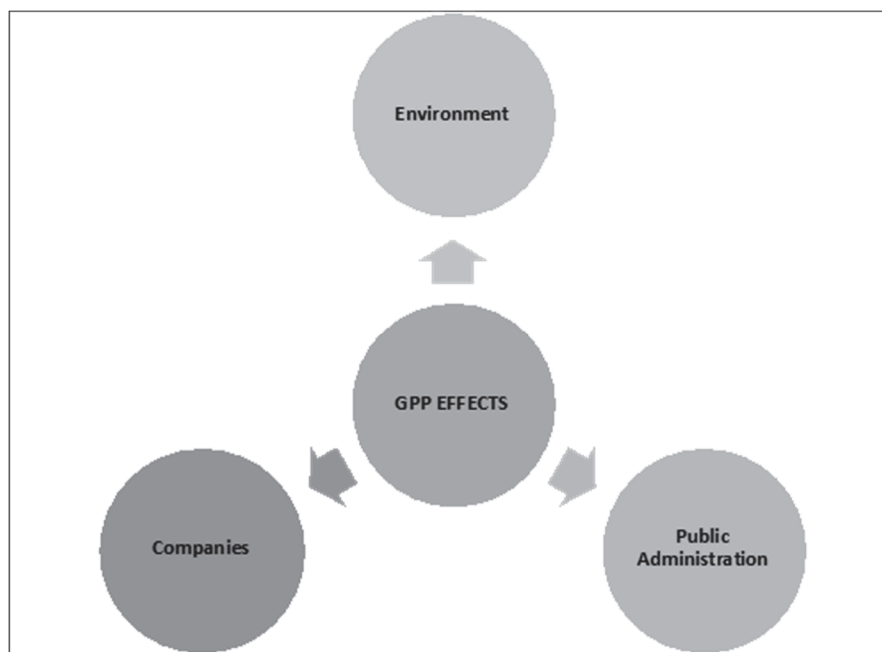


Fig. 1. Basic framework

Methodologically, this paper is based on a review but aims to identify some key issues related to GPP. Hence, this study not is a purely scientific interest analysis, but a reasoned discussion on the critical issues of GPP.

Lastly, this paper contains a critical analysis of the barriers that obstacle the GPP adoption in order to provide some solutions for overcoming and make the procurement procedure simple and sustainable, not only environmentally. Hence, the barriers exploration that constrain the adoption of GPP provides a better understanding of the adoption of GPP (Navarani et al., 2020).

2. Theoretical framework

With the aim to analyze the scientific interest about GPP, the authors performed a research on Scopus database. Using Green Public Procurement term in the “TITLE-ABS-KEY”, the query revealed 536 scientific documents (Fig. 2) in which the term “GPP” was found at least in their title, summary or keywords. In 2021 it was recorded a pick with 81 articles, followed by 2022 with 60 publications. Subsequently, comparing the documents by country/region of publications, it emerged Italy as country in the top with 69 articles, equal of 12% of the total production.

The scholars that studied mainly GPP are Iraldo and Liu with 8 publications each, followed by Apolloni and Testa with 6. The articles represent 62.9% of production, 17.2% are conference papers, and other studies between book chapters (9.1%), reviews (5.4%), books (1.9%), conference review (1.7%) and other kinds with percentage less than 1% (note, editorial, erratum, short survey) (Table 1).

Only 20.9% are studies included in Environmental Sciences area, 15.0% in Social Sciences, 14.0% in Engineering, 12.8% in Business, Management and Accounting, 12.5% in Energy, 7.7% in Economy, Economics and Finance and other areas with less than 4% coverage.

Moreover, it has been stressed that 14 articles were elaborated under the sponsor of the European Commission: this event is explained by the European funding finalized with the adoption of the GPP in member countries, as Italy.

After this general analysis, the authors explored the scientific literature on Scopus platform using a composed string in “Green Public Procurement” AND “Public administration”. The results quantified 35 scientific products. Moreover, adding a third element like “Europe”, the results showed 3 papers. Then, considering the three results obtained and analyzing abstract, keywords and introduction the unique article published in line with our study was a documental analysis of European Practices processed by Litardi et al. (2020). The authors presented a study on the state of the art of GPP in the new trends promoted by the United Nations Agenda 2030. They mapped the main practices and their environmental impact, using a qualitative research methodology such as the documentary analysis of the most important GPP practices, divided into 129 documents and separated for each sector. Subsequently, analyzing the scientific production on Italian adoption of GPP, using “Green Public Procurement” AND “Public administration” AND “Italy” the unique study in line with this topic was elaborated in Spanish by Fuentes Bargues et al. (2021), and focused of Piedmont Region, in Northwest Italy.

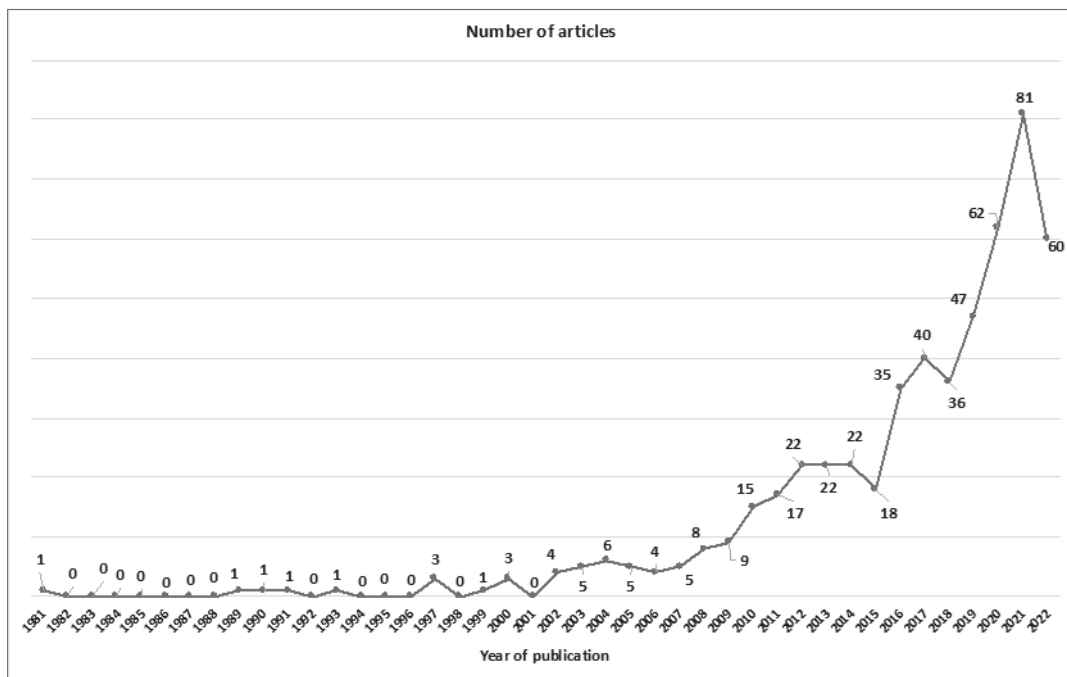


Fig. 2. Documents per year

Table 1. Most representative publications

<i>Authors</i>	<i>Year</i>	<i>Title</i>	<i>Journal</i>
Apolloni et al.	2013	Is public procurement going green?: Experiences and open issues	<i>Experience and Open Issue</i>
Apolloni et al.	2014	Green Procurement in the private sector: A state of the art review between 1996 and 2013	<i>Journal of Cleaner Production</i>
Bartolozzi et al.	2018	The application of life cycle assessment (LCA) in municipal solid waste management: A comparative study on street sweeping services	<i>Journal of Cleaner Production</i>
Cheng et al.	2018	Green Public Procurement, missing concepts and future trends – A critical review	<i>Journal of Cleaner Production</i>
De Giacomo et al.	2019	Does Green Public Procurement lead to Life Cycle Costing (LCC) adoption?	<i>Journal of Purchasing and Supply Management</i>
Liu et al.	2021	How external stakeholders drive the green public procurement practice? An organizational learning perspective	<i>Journal of Public Procurement</i>
Liu et al.	2019a	Improving the green public procurement performance of Chinese local governments: From the perspective of officials' knowledge	<i>Journal of Purchasing and Supply Management</i>
Liu et al.	2019b	Enhancing green public procurement practices in local governments: Chinese evidence based on a new research framework	<i>Journal of Cleaner Production</i>
Ma et al.	2021	Does green public procurement encourage firm's environmental certification practice? The mediation role of top management support	<i>Corporate Social Responsibility and Environmental Management</i>
Marucci et al.	2021	Investigating the management challenges of the EU Ecolabel through multi-stakeholder surveys	<i>The International Journal of Life Cycle Assessment</i>
Marucci et al.	2019	The integration of circular economy with sustainable consumption and production tools: Systematic review and future research agenda	<i>Journal of Cleaner Production</i>
Nucci et al.	2016	The relevance of life cycle costing in green public procurement	<i>Economics and Policy of Energy and the Environment</i>
Rizzi et al.	2014	Environmental value chain in green SME networks: The threat of the Abilene paradox	<i>Journal of Cleaner Production</i>
Testa et al.	2016a	Examining green public procurement using content analysis: existing difficulties for procurers and useful recommendations	<i>Environment, Development and Sustainability</i>
Testa et al.	2016b	Drawbacks and opportunities of green public procurement: An effective tool for sustainable production	<i>Journal of Cleaner Production</i>
Testa et al.	2012b	What factors influence the uptake of GPP (green public procurement) practices? New evidence from an Italian survey	<i>Ecological Economics</i>
Wang et al.	2020	Price/time/intellectual efficiency of procurement: Uncovering the related factors in Chinese public authorities	<i>Journal of Purchasing and Supply Management</i>
Wang et al.	2021	Green public procurement as a promoter for green consumption: From the perspective of individual's knowledge	<i>Cleaner and Responsible Consumption</i>
Ye et al.	2022	Why do public sectors perform high-level green public procurement practice? A new insight with fsQCA approach	<i>Journal of Environmental Planning and Management</i>

Particularly, the scholars investigated how procurement is green, recognizing public purchasing authorities a leadership position in promoting greening of operations (Apolloni et al., 2011; Apolloni et al., 2014), focused on the role of Life Cycle Approaches useful to analyze the impact of particularly products and goods involved in procurement (Bartolozzi et al. 2018; De Giacomo et al., 2019; Nucci et al., 2016), examined the integration of circular economy with sustainable consumption and production (Testa et al., 2016).

This shortage in the scientific publication (Table 1) led the authors to carry out this study to enrich the production and provide an overview to the stakeholders involved in the sector. The structure of the papers contains a section of introduction, presenting the essential elements of the GPP, a theoretical framework in second section and material and methods used for the analysis presented in section 3. Moreover, section 4 presents the results obtained analyzing different element associated to GPP, first of all the technical/economic/social obstacles to apply

GPP in public procurement, subsequently the role of GPP in Circular Economy Action Plan, an examination of the differences between Green Public Procurement and Sustainable Public Procurement, the importance of LCC (Life Cycle Costing) in GPP implementation, GPP in Italian Analysis. In this section authors presented the GPP in Italian National Ecological Transition and the numbers of the GPP in Italy. Subsequently, authors presented a best practice about GPP in energy sector. Therefore, the general question who drove this article is “what are the barriers that obstacle the implementation of GPP at national level?”.

3. Materials and methods

This section has been elaborated through a structured analysis, starting from the scientific literature, regulations, laws and technical reports published in recent years. Considering that GPP has been presented for the first time in Rio de Janeiro in 1992 at the UN Conference on Environment and Development, this analysis carried out at Italian level with the aim of making a critical analysis within the Next Generation EU program, which involves different European member countries, including Italy.

Contemplating that European public authorities and member states as Italy are large consumers of goods and services produced and supplied by small and medium-sized enterprises and large companies, corrective measures for producing and procurement need to be taken. These products, if not accurately identified, generate significant impacts on the environment, such as emissions of carbon dioxide, waste and hazardous waste, consumption of natural resources and impacts on urban areas and populations. At European level, the first analysis is based on European regulation on GPP and are worth drawing attention to:

a) For Defining the requirements of a contract: “Defining technical specifications is guided through Article 42 and Annex VII of Directive 2014/24/EU; and Article 60 and Annex VIII of Directive 2014/25/EU”,

b) For Use of labels: “Conditions for using labels are laid out in Article 43 of Directive 2014/24/EU; and Article 61 of Directive 2014/25/EU”,

c) For Lowest price award and life-cycle costing (LCC): “Awarding public contracts on the basis of the most economically advantageous tender is provided as part of Article 67 of Directive 2014/24/EU; and Article 82 of Directive 2014/25/EU”,

d) For Innovation partnerships: “The procedure for establishing an innovation partnership is set out in Article 31 of Directive 2014/24/EU”,

e) For Consulting the market: “The procurement directives specifically allow for preliminary market consultation with suppliers in order to get advice, which may be used in the

preparation of the procedure. Article 40 of Directive 2014/24/EU (European Commission, 2014)”.

The EU also required to define clearly the concept of GPP: it must be a verifiable and justifiable environmental criterion, based on a life cycle approach and scientific evidence (COM (2008) 400) by recommending the creation of a process for the definition of common criteria for GPP.

Therefore, since 2008 the Commission has developed more than 20 common GPP criteria through a multi-criteria analysis including: scope of environmental improvement; public spending; potential impact on suppliers; potential to lead by example for private/corporate consumers; political sensitivity; existence of relevant and user-friendly criteria; market availability and economic efficiency. Table 2 shows these criteria that has been updated regularly.

Table 2. European GPP Criteria*

<i>Developed criteria</i>	<i>Under development criteria</i>
copying and graphic paper	food and catering
computer and monitors	cleaning services
transport	imaging equipment
electricity	transport
textiles	street lighting
cleaning products and services	data centers
office buildings	public space management
furniture	
food & catering services	
gardening products and services	
water based heaters	
waste water infrastructures	
flushing toilets & urinals	
imaging equipment	
roads	
road lighting and traffic signals	
sanitary tapware	
health care sector	
paints and varnishes	

*Authors' elaboration on European Commission and Lombardia Region, 2022; *GPP criteria for products are largely based on standard Type I ecolabels*

Particularly, recently EU has updated several criteria (Table 2) for cleaning products and services, computers, monitors, tablets and smartphones, data centers, server rooms and cloud services, electricity, food and catering services and vending machines, furniture, imaging equipment, consumables, print services, office building design, construction and management, paints, varnishes and road markings, public space maintenance, road design, construction and maintenance, road lighting and traffic signals, road transport, textiles. Hence, considering that Italy is a European member state, these criteria must also be applied in Italian public procurement.

More generally, conducting an analysis of the Italian level of adoption, GPP was introduced in Italy in 2008 with the National GPP Action Plan which provided for the adoption, with subsequent ministerial decrees, of the Minimum Environmental Criteria (MEC) for each category of products, services and works purchased or entrusted by the Public administration.

In Italy, the application of the MEC has been ensured by art. 18 of Law 221/2015 and by article 34 containing “Criteria for energy and environmental sustainability” (Table 3) of Legislative Decree 50/2016 “Procurement Code”, which made it mandatory for all contracting authorities to apply it.

Table 3. Italian MEC criteria

<i>Developed criteria</i>	<i>Under adoption criteria</i>	<i>Under development criteria</i>
Interior furnishings	Design services and works for the new construction and maintenance of roads	Cultural events
Street furniture	Supply and rental of textile products	Food and beverage sales services (indoor bars and vending machines)
Supports for incontinence		Urban furniture
Work shoes and leather accessories		PC and server
Paper		Public transport service
Building		Energy services for buildings
Public lighting (service)		
Lighting, heating / cooling for buildings		
Industrial washing and rental of textiles and mattresses		
Urban waste and street sweeping		
Collective catering		
Disinfection		
Printers		
Public green Cartridges		
Public lighting (supply and design)		
Textiles		
Vehicles		

Authors' elaboration on MITE, 2022

Table 3 shows the evolution in MEC Italian Criteria, highlighting how Italy is steadily operating towards a complete green transition of public procurement. Moreover, recently, a directorial decree established the planning of activities aimed at defining the minimum environmental criteria preliminary to the adoption of the related ministerial decrees, for the year 2023 (MITE, 2023).

As highlighted by the European Commission, the criteria used by the Member States (e.g. MEC in Italy, see Table 3) must be similar to the general criteria of the GPP (Table 2) and suitable to avoid distortion of the single European market and the consequent reduction of competition. Therefore, choosing common criteria across member countries and at European level, this significantly reduces the administrative burden for economic operators and public administrations implementing GPP. Therefore, having common GPP criteria is an advantage for companies operating in more than one Member State and for SMEs and public administrations managing public procurement.

Then in order to carrying out a structured study, the authors envisaged some research questions developed after analyzing some reports and some scientific articles.

3.1. Research questions

RQ1. The GPP implementation is obstructed by some technical, social and economic limits that cannot be overcome.

RQ2. The terminological confusion of the approaches does not support the stakeholders.

RQ3. The absence of technical standards and holistic approaches does not convince public administrations to use GPP.

RQ4. Italy is a country lagging behind in adopting the GPP.

RQ5. At the European level, there are no funding programs to favor GPP in the energy sector.

4. Results and discussion

In this section the authors presented the obstacles to implementation of GPP, the role of GPP in the Circular Economy Action Plan, the differences between two approaches, the Green Public Procurement (GPP) and the Sustainable Public Procurement (SPP), the innovative LCC approach for GPP, the GPP in Italian public administration and a case study with the aim of addressing the themes proposed in the research questions.

4.1. Obstacles to GPP

A survey conducted by the European Commission on “Green Public Procurement in Europe” revealed numerous barriers for the implementation of GPPs at European level. In Table 4 authors inserted in the first column the barriers that restrict the adoption of GPP followed by a synthetic

description. Moreover, in third column authors proposed a possible solution in order to overcome the obstacles. Then, the hypothesis of RQ1 is not verified because there are many barriers but they can be overcome through systematic activities and behaviors starting from correct communication and training.

4.2. Green Public procurement in circular economy action plan

An evolution to GPP is the “circular procurement” that defines an approach to green public procurement with particular attention “to the purchase of works, goods or services that seek to contribute to the closure of energy and material circuits within

supply chains, reducing to a minimum and, in the best of cases, avoiding environmental impacts and the creation of waste along the entire life cycle”.

These kinds of procurement:

- a) allow buyers to focus on meeting needs,
- b) consider life cycle costs with potential savings,
- c) provide a framework for a more holistic consideration of environmental impacts and creation of waste along the entire life cycle of goods and services (European Commission, 2022).

For this reason, in order to support public buyers to leverage support for a transition to a circular economy, the European Commission published the “Public Procurement for a Circular Economy” manual in 2017.

Table 4. Barriers and possible solution for GPP implementation at European level

Barriers to adoption GPP	Description	Solutions
Lack of political support	Many public authorities complained about the lack of support in the implementation of the GPP. The reason for this difficulty is associated with a lack of awareness of the importance of the GPP agenda of European civil servants and purchasing staff	1) train senior officials and GPP practitioners 2) provide tools and indications necessary to implement the approach 3) update with new regulations and technical evolutions
Green products are perceived to cost more	Using the purchase price alone to decide between offers, rather than the cost of the entire life cycle of the product or service, can affect the adoption of ecological products and services and not justify a difference in price between product/service traditional and green product/service	1) use a life cycle costing (LCC) approach to calculate the financial impact of GPP 2) do not use only the purchase price of the product/service 3) the average financial impact of GPP is lower because maintenance and disposal costs decrease
Lack of legal expertise in applying environmental criteria	Many senior public purchasing officials do not and cannot be aware of all the environmental and social impacts of purchasing certain products or services In some cases, senior officials and buyers still struggle to define what an "environmentally and/or socially preferable" product or service is and how to include appropriate criteria to identify them in the procurement process	Provide technical data sheets of the products with the indications of: a) the environmental criteria b) the reduced impacts c) the production and disposal procedures
Lack of practical tools and information	Continuous lack of practical tools and information both in the purchase phase and in the use and disposal phase	Overcoming this gap by publishing information on international, community and national digital platforms
The need for systematic implementation and integration into management systems	Decentralized organizations require effective management systems to ensure the consistent application of environmental and social initiatives – and this applies equally to GPP.	Joint procurement/contracting and public/private partnerships are possible approaches to overcome these types of obstacles
Lack of training	The staff responsible for carrying out specific tasks (from the preparation of contracts, to execution and control) does not always have the appropriate skills and training	Optimize the training required of contractors and subcontracted stations on the legal and technical aspects of GPP implementation, on the concept of life cycle cost and for end users on the sustainable use of products
Lack of co-operation between authorities	Systematic implementation of GPP between different public authorities is still completely absent and is an obstacle to implementation	1) Need to push for informal and formal cooperation between public authorities to improve GPP 2) Promote a coordinated exchange of good practices and networks between authorities.
Limited established environmental criteria for products/services	Lack of clear and accurate information for many product and service groups and difficulty in accessing clear and verifiable criteria that allow them to incorporate environmental considerations into tenders	Provide a clear and organized communication of the criteria to be considered in the procurement, use, disposal phase

Source: Authors' elaboration on European Commission (2020)

This publication contains a series of good practice case studies and a guide on integrating circular economy principles into procurement.

Therefore, recognized the key role of the Circular Economy, this new approach:

- a) placed particular emphasis on aspects of the circular economy in terms of setting criteria,
- b) supported greater dissemination of GPP criteria by public authorities,
- c) has required training and ongoing assistance,
- d) has guaranteed the accompaniment of the Commission and an increase in funding.

4.3. Differences between Green Public Procurement and Sustainable Public Procurement

Generally, sustainable public procurement (SPP) supports the organization's sustainability goals and optimizes environmental, social, and economic impacts throughout the product or service life cycle. Therefore, it does not only consider purely environmental aspects. Hence, SPP includes complying with environmental laws and objectives, removing hazardous/prohibited materials and wastes in the supply chain, thoroughly auditing suppliers for fair labor practices, operating for the long term (CIPS, 2023). According to a definition by Rodriguez-Plesa et al. (2022) the "Sustainable Public Procurement (SPP)" consists of a mechanism for governments to address problems strategically using government funds efficiently and effectively, promoting the well-being of the environment, economy and society.

Conversely, according to a definition by the Commission of the European Parliament (2008), the "Green public procurement" is a process by which authorities seek to purchase goods [...], with reduced environmental impact throughout their life cycle compared to goods [...] with the same primary function that would otherwise be purchased".

Analyzing the main characteristics between GPP and SPP, it emerged that:

1) GPP approach is characterized by the presence of two types of criteria for each covered sector:

- a) "core criteria, which can be used by any contracting authority in the Member States, address key environmental impacts and are designed to be used with minimal additional verification effort or increased costs",
- b) "comprehensive criteria, suitable for those who wish to purchase the best environmental products available on the market, and may require additional verification effort or a slight cost increase compared to other products with the same functionality".

2) Sustainable Public Procurement (SPP) is an interconnected and interdependent system consisting of the environmental, social and economic dimensions (Rodriguez-Plesa et al., 2022):

- a) above all the environmental dimension was included in the existing literature (Grandia and Kruyen, 2020),

- b) the economic dimension focused on the material well-being of all people (Fiorino, 2010),

- c) the social dimension emphasizes an "effective, stable and democratic government" (Fiorino, 2010).

However, the social and economic dimensions have overlapping elements because they are focused on people.

At the government level, many public authorities in the EU are implementing GPP as part of a broader approach to sustainability in their purchasing, which also addresses economic and social aspects. Instead, the United Nations developed a detailed guide on SPPs to address all three aspects of sustainability (economic, social and environmental) and summarize the operation as "Buying for a Better World".

Then, when discussing sustainability in public procurement public administration are operating according economic, social and environmental sustainability, towards the three levels of sustainability that do not only concern the environment. Conversely, green public procurement only refers to environment. In conclusion, RQ2 is verified. These two approaches can confuse public administrations in the approach to be adopted because they often do not know the difference.

4.4. Life Cycle Costing (LCC)

The use of GPP supports various environmental policy tools, in line with the logic of the Integrated Product Policy promoted at European level, such as the improvement programs prepared as part of EMAS or ISO 14001 processes or the action plans of the Agenda 21 or simply the political will of the institution to improve its environmental impacts and demonstrate the results internally and externally, as highlighted in MITE (2007).

Therefore, the criteria indicated in Tables 3-4, to be functional to the purpose of the GPP, must be evaluated on the basis of methodology proposed in the National Plan on GPP (for the Italian case) with reference to market analysis. Therefore, these can also be accompanied, where appropriate, by cost-benefit analyzes or by LCC analyzes, bearing in mind, in general, the concept of sustainability.

In scientific literature, Querol et al. (2020) analyzed life cycle cost (LCC) as a useful tool for green public procurement (GPP). The cost savings obtained during the life of the product are negatively offset by the price premiums linked to the impact on the environment. Therefore, through the environmental component of the LCC the authors included not only the "internal" costs but also the "external". The LCC internalizes externalities to consider environmental aspects in addition to the usual elements of operating, maintenance and end-of-life costs. Hence, this option consists in defining stringent environmental technical specifications to ensure an ecological result and using this approach as an award

criterion when selecting among alternatives already considered ecological.

Unfortunately, despite its usefulness, LCC is little used in public procurement because PAS have not yet understood its potential and effectiveness. However, at the EU level the new directive on public procurement has been issued which recognizes the LCC as a key role in operations conducted for sustainable procurement (De Giacomo et al., 2019).

Therefore, this kind of operation is regulated by the technical standard, the ISO 15686-5:2017, "which provides requirements and guidelines for performing life cycle costing (LCC) analyzes of buildings and constructed assets and their parts, new or existing". Therefore, RQ3 is not verified because there isn't a lack of technical standards and holistic approaches to coexist public administrations in using GPP. Indeed, it is enough to consider the LCC or the various certifications regulated by technical standards.

4.5. GPP in Italian analysis

Among the EU member states, the authors analyzed the GPP implementation in Italy. For this reason, they present two subsections, the first about the national program of the ecological transition and the second dealt with the diffusion of this approach among public administrations.

4.5.1. GPP in Italian national ecological transition

At national level, starting from the indication contained in the Communication of the European Commission "Integrated product policy, develop the concept of the environmental life cycle" (COM (2003) 302), the Ministry of Ecological Transition has developed the "action for the environmental sustainability of public administration consumption" (PAN GPP). This tool provided a general framework on GPP, defined national objectives, identified the categories of goods, services and priority intervention works for environmental impacts and the volumes of expenditure on which to define the Minimum Environmental Criteria (MEC) (MITE, 2017).

Moreover, the PAN GPP also orders specific requirements for public bodies, which are called to carry out an analysis of their needs with the aim of rationalizing consumption and favoring decoupling (the dissociation between economic development and environmental degradation), identifying the functions responsible for the implementation of the GPP involved in the purchasing process, draw up a specific internal program to implement the actions in the GPP area. In particular, it invites Provinces and Municipalities to promote energy efficiency measures in the school buildings of competence. Finally, the PAN GPP provides for annual monitoring to verify its application, with relative analysis of the environmental benefits obtained and the training and

dissemination actions to be carried out on the national territory (MITE, 2017).

4.5.2. The numbers of the GPP in Italy

There are 18 Italian municipalities that declared that always apply MEC: Belluno, Bolzano, Brescia, Chieti, Cuneo, Ferrara, Forli, Imperia, Latina, Mantua, Modena, Monza, Padua, Pavia, Pordenone, Rimini, Savona and Trento. Furthermore, the cities that have an application rate between 99% and 99.99% compared to the 17 monitored MECs are 9: Bari, Bologna, Gorizia, Livorno, Ravenna, Turin, Treviso, Venice and Verona (Table 5).

As shown in Table 5, other 8 municipalities shown percentages between 88% and 99% such as Brindisi, Cremona, Oristano, Perugia, Pistoia, Reggio Emilia, Syracuse and Teramo. It emerged that the highest rates of adoption of MEC are medium-sized cities, with a population between 50,000 and 200,000 inhabitants, such as Trento (Table 5).

Technically, the synthetic indicator of GPP expresses the systematic commitment of an administration in the implementation of this policy: it is higher than 0.90 in provincial capitals such as Bolzano, Modena, Monza, Padua, Rimini, Teramo, Turin. On the other hand, the administrations that do not adopt the MECs do not even adopt the GPP policy. Moreover, GPP process indicators and MEC adoption indicators are two indexes elaborated with the aim to indicate, respectively, the level of application of GPP criteria and MEC criteria. The sum of these two indicators reveals the synthetic GPP Indicator. Generally, these indicators quantify the performance on the GPP implementation in Italy.

Practically, amongst the factors that facilitate the adoption of MEC and GPP, the authors highlighted knowledge of GPP (almost 90%), training on GPP, monitoring, social criteria, gender equality, the adoption of plastic-free policies. As shown in the Fig. 3, the MEC most used by the municipalities are those relating to the purchase of paper and cleaning services (over 70%), followed by printers, toner cartridges and paper graphics (between 60% and 70%). These are activities prevalent in all public administrations. Conversely, the least used MECs, with values between 30% and 40%, are related to vehicles, energy services, textiles and footwear.

Particularly, considering that some sectors presented the same level of influence in the environmental impact generated by public administration activities, the percentage of application of MEC by these areas is equal (e.g. printers and cartridges, energy services and road vehicles).

Notwithstanding, from the data analyzed and presented at a general level, Italy is not a country lagging behind in the adoption of the GPP, indeed many regions and countries have achieved a full application of it. So, RQ4 is not true.

Table 5. Statistics on GPP and MEC adoption in Italy (2021)*

Municipalities capital of the Region	Inhabitants (in millions)	GPP Process Indicators	MEC adoption indicators	% MEC adoption	Synthetic GPP Indicator
Roma	2.864	0.23	0.18	n.d.	0.40
Milano	1.372	0.25	0.45	64.3	0.70
Napoli	0.962	0.30	0.00	0.00	0.30
Torino	0.878	0.30	0.65	92.3	0.95
Palermo	0.666	0.30	0.35	50.0	0.65
Genova	0.578	0.12	0.45	64.3	0.57
Bologna	0.390	0.20	0.65	92.9	0.85
Firenze	0.381	0.30	0.44	62.5	0.74
Bari	0.322	0.12	0.65	93.3	0.77
Venezia	0.261	0.25	0.64	91.7	0.89
Trieste	0.204	n.d.	n.d.	n.d.	n.d.
Perugia	0.166	0.23	0.59	84.6	0.82
Cagliari	0.154	0.20	0.43	61.5	0.63
Trento	0.118	0.15	0.70	100.0	0.85
Ancona	0.101	0.10	0.26	37.5	0.36
Catanzaro	0.089	0.08	0.35	50.0	0.43
L'Aquila	0.678	0.30	0.31	43.8	0.61
Potenza	0.670	0.30	0.00	0.00	0.30
Campobasso	0.492	0.05	0.19	26.7	0.24
Aosta	0.339	0.15	0.32	46.2	0.47

*Trieste did not reply to the OAV 2022 questionnaire on GPP; Source: Authors' elaboration on Falocco et al. (2022)

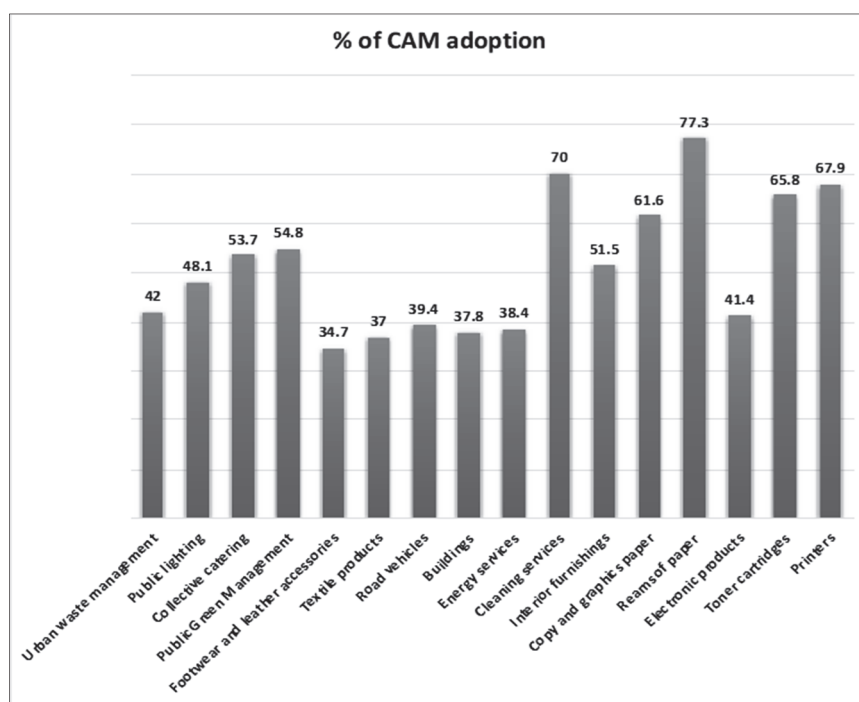


Fig. 3. MEC adoption rate in the Italian capital municipalities, 2021 (in%)
Source: Authors' elaboration on data Falocco et al. (2022)

4.6. GPP in energy industry – The XPRESS Project case study

With the aim to implement a close cooperation between public and private sector and for creating a useful partnership that facilitate the implementation of the GPP, European Union launched various tools. Particularly, in the renewable energy sector, for example, an important project, the XPRESS, has been planned. This project, funded by the Horizon Europe 2020 program for research and innovation of the

Union program, aims to facilitate introduction technologies of Renewable Energy Sources and increasing their share in final energy consumption along two dimensions:

- 1) through the use of Smart Green Public Procurement (SGPP), to create the new market and strengthen the performance of innovators in Renewable Energy Sources (RES) technologies,
- 2) with the development of innovative financing tools and the sharing of best practices with the aim of supporting the innovation of SMEs (Small

and Medium Enterprises) and producing new RES technologies.

The XPRESS program initially focused on cities and municipalities in Italy, the United Kingdom, Norway, Germany, Sweden, Spain, Denmark, Slovakia, Portugal and Belgium with the aim of extending the analysis and involvement to wider regions of all European countries. Nevertheless, the general aim is to facilitate the adoption of GPP in the energy sector. This program allows you to operate on several levels: understanding the problem, finding the solution, preparing a financial analysis with constraints on RES innovations, analyze barriers and innovative challenges in GPP for both stakeholders involved, public authorities and SMEs, analyze the environmental impact of RES Innovations carried out through GPP.

Furthermore, with this project, public authorities and SMEs can be supported in minimizing any financial and regulatory constraints that affect their collaboration, organizing GPP co-creation workshops, coffee moments between stakeholders (SMEs and policy makers), collection of eco-design and examples of good practices, recommendations for the use of RES solutions (XPRESS, 2022).

Italy, through EURADA, the European Association of Development Agencies, has created a moment to bring together Italian PAs and SMEs gathered in Venice for the XPRESS Co-creation Policy Workshop on the development of GPP in the renewable energy sector. Moreover, the need to overcome the bureaucratic, financial and technical barriers that hinder the full involvement of public administrations and innovative companies in the development of Green Public Procurement (GPP) in the renewable energy sector was discussed. Through this partnership, between Italy, the Express Program and EURADA, the need to acquire responsible

behaviors for the reduction of CO₂ emissions in the area of the Po river basin, for example, an area critical for air quality, was highlighted. and pollution (EURADA, 2022). For this reason, there are several financing programs to support the implementation of the GPP in the energy sectors (RQ5).

4.7. Possible actions to adopt GPPs in the future

Firstly, as Navarani et al. (2020) underlined, among the major obstacles emerged: not providing for the obligation in some sectors (Ahsan and Rahman, 2017), difficulties in carrying out the procedures (Hall et al., 2015), not specifying the method of transport of the product and the frequency of deliveries to predict more sustainable hypotheses (Thomson and Jackson, 2007), non-indication of the achievable level of sustainability (Adjei-Bamfo and Maloreh-Nyamekye, 2019). For this reason, the problems related to obstacles to GPP implementation can be solved in various modes. Among these stand out above all (Fig. 4):

- a) Modify calls for tenders and communications to businesses,
- b) Implement adequate internal staff training, Initiate specific monitoring activities.

Figure 4 includes the results of a survey carried out by Legambiente (2021) in Italy for analyzing the adjustment actions due to the GPP. The answers highlighted as the first area of intervention consists of a change in the process of preparing and communicating with companies (first column), which is followed by the internal training of personnel (second column), subsequently moving on to the activity of monitoring or updating internal information systems such as networking and external support. Finally, to a lesser extent there is interest in hiring new personnel.

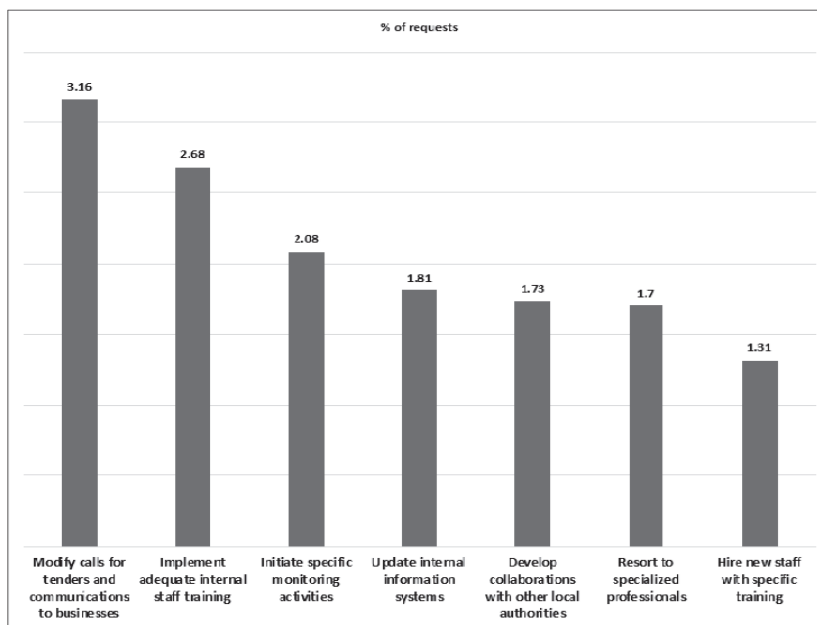


Fig. 4. Possible solution to increase MEC adoption rate in the Italy (in %) (authors' elaboration on data Falocco et al., 2022)

Of minor importance, the authors emphasized the hiring of new staff with specific training. Therefore, by adopting the GPP and the MEC in Italy, as well as in other countries, important benefits can be achieved: Therefore, by adopting the GPP and the MEC in Italy, as well as in other countries, important benefits can be achieved:

- a) 35% of the fallout are positive territorial impact from the point of environmental and / or social view,
- b) 25% improvement of the image towards citizens and users,
- c) 15% reduction of environmental management costs (e.g. waste, energy),
- d) 12.5% rationalization of public spending,
- e) 11% better access to Community funding (criterion reward) (Falocco et al., 2022).

Furthermore, considering that sustainability innovation is an integrated and interdependent process between PA and Companies, through the collaboration of stakeholders, as Cillo et al. (2019) underlined, a public service company can be a strategic player in the improvement of local policies towards sustainability (Annesi et al., 2023).

4. Conclusions, limitations and future implications

GPP represent 14% of GDP (Gross Domestic Product) and include environmental, economic, social and political benefits. Particularly, in environmental field this approach allows to decrease GHG and hazardous substances, increase resource and energy efficiency. From the economic point of view, the GPP approach supports the achievement of environmental obligations, shows commitment to the protection of the environment, sustainable consumption and production. Furthermore, politically, it supports the growing diffusion of green technologies and products, supporting innovation. Finally, it also supports the social issue by improving health and well-being of populations with less impacting products and services.

Among the major obstacles, it emerged the lack of knowledge and awareness. However, the financial constraint is not the main obstacle for GPP implementation, as previously perceived, because especially in Italy it is favored by funding from the NRRP. However, widespread barriers can be considered: limited budget, precise legislation, involvement of people such as customers and suppliers, lack of knowledge and awareness, decentralization of purchasing, GPP policy and strategies, size of the organization, political and top management commitment, lack of monitoring evaluation and lack of incentives.

Therefore, for the future authorities must carry out the control of the appropriate execution of the contracts and set up a legislative observatory GPP and MEC, for verifying that each local authority operates on the basis of a regional action plan and that a bank is planned “green” procurement data. Moreover, a positive note that could accelerate the adoption of

GPPs is the introduction of the DNSH (Do no significant harm) approach at European level, a principle according to which the interventions envisaged by the Italian NRPP must not cause significant damage to the environment. Therefore, GPP can be considered an important operational and evaluation tools for the sustainable management of materials and energy in a public administration that moves towards the Circular Economy. Moreover, GPP supports public administrations to achieve the environmental sustainability of their countries earlier.

This review mainly investigated the barriers for GPP adoption, conducting a comparative and qualitative research, focusing on the Italian case. For the future, more investigations are needed at different levels and for different sectors to understand in quantitative terms also the nature of barriers. In this first study, it was not possible to quantify the criticality of the barriers as it was decided to observe the phenomenon in order to build a quantitative analysis model for a future application.

In conclusion, future research should explore a shift from green procurement to sustainable procurement, contemplating environmental, economic and social sustainability aspects, also favoring the application of life cycle costing approaches. In this way public administrations can benefit and not damage the environment and humanity.

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References

- Adjei-Bamfo P., Maloreh-Nyamekye T., Ahenkan A., (2019), The role of e-government in sustainable public procurement in developing countries: a systematic literature review, *Resources, Conservation and Recycling*, **142**, 189-203.
- Ahsan K., Rahman S., (2017), Green public procurement implementation challenges in Australian public healthcare sector, *Journal of Cleaner Production*, **152**, 181-197.
- Alkadry M. Trammell E., Dimand A.M., (2019), The power of public procurement: social equity and sustainability and externalities and as deliberate policy tools, *International Journal of Procurement Management*, **12**, 336-362.
- ANAC, (2022), Report to Parliament on the activity carried out by ANAC in 2021, (in Italian), On line at: <https://www.anticorruzione.it/documents/91439/39459199/2.ANAC+-+Relazione+annuale+2022+-+Mercato+appalti.pdf/7c528e73-285a-3735-c813-c717e7a2ce73?t=1655914102317>
- Annesi N., Battaglia M., Sganzzetta L., (2023), Mutual benefits of sustainability integration in the value chain: Responsible innovation by public utilities, *Utilities*

- Policy*, **82**, 101564, <https://doi.org/10.1016/j.jup.2023.101564>.
- Apolloni A., Sun H., Jia F., Li X., (2014), Green Procurement in the private sector: A state of the art review between 1996 and 2013, *Journal of Cleaner Production*, **85**, 122-133.
- Appolloni A., D'Amato A., Cheng W., (2011), Is public procurement going green? *Experiences and Open Issues*, <http://dx.doi.org/10.2139/ssrn.1970583>.
- Bartolozzi I., Baldereschi E., Daddi T., Iraldo F., (2018), The application of life cycle assessment (LCA) in municipal solid waste management: A comparative study on street sweeping services, *Journal of Cleaner Production*, **182**, 455-465.
- Castelnovo P., Clò S., Florio M., (2023), A quasi-experimental design to assess the innovative impact of public procurement: An application to the Italian space industry, *Technovation*, **121**, 102683, <https://doi.org/10.1016/j.technovation.2022.102683>.
- Cheng W., Apolloni A., D'Amato A., Zhu Q., (2018), Green Public Procurement, missing concepts and future trends – A critical review, *Journal of Cleaner Production*, **176**, 770-784.
- Cillo V., Petruzzelli A.M., Ardito L., Del Giudice M., (2019), Understanding sustainable innovation: a systematic literature review, *Corporate Social Responsibility and Environmental Management*, **26**, 1012-1025.
- CIPS, (2023), Why sustainable procurement continues to be important?, On line at: <https://www.cips.org/intelligence-hub/sustainability/sustainable-procurement>
- Commission of the European Parliament, (2008), Public Procurement for a Better Environment. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, On line at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52008DC0400&from=EN>
- De Giacomo M.R., Testa F., Iraldo F., Formentini M., (2019), Does Green Public Procurement lead to Life Cycle Costing (LCC) adoption?, *Journal of Purchasing and Supply Management*, **25**, 100500, <https://doi.org/10.1016/j.pursup.2018.05.001>.
- De Giacomo M.R., Testa F., Iraldo F., Formentini M., (2019), Does Green Public Procurement lead to Life Cycle Costing (LCC) adoption?, *Journal of Purchasing and Supply Management*, **25**, 100500, <https://doi.org/10.1016/j.pursup.2018.05.001>.
- EC, (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, Brussels, On line at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52008DC0397>.
- EURADA, (2022), Italian PAs and SMEs gathered in Venice for the XPRESS Co-creation Policy Workshop about the development of GPP in Renewable Energy Sector, On line at: <https://www.eurada.org/news/detail/italian-pas-and-smes-gathered-in-venice-for-the-xpress-co-creation-policy-workshop-about-the-development-of-gpp-in-renewable-energy-sector>
- European Commission and Lombardia Region, (2022), EU Green Public Procurement (GPP) – Policy, On line at: https://www.regione.lombardia.it/wps/wcm/connect/c217f834-1be3-45da-a87e-1a2d9705576d/02_INFODAY+GPP_Commissione+Europea_De+Giorgis.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-c217f834-1be3-45da-a87e-1a2d9705576d-mKupQW0
- European Commission, (2014), EU public procurement directives, On line at: https://ec.europa.eu/environment/gpp/eu_public_directives_en.htm
- European Commission, (2020), EU Green Public Procurement (GPP) Policy, On line at: <https://noharm-europe.org/sites/default/files/documents-files/4441/1%20Robert%20Kaukewitsch.pdf>
- European Commission, (2021), Public Procurement Indicators 2018, On line at: <https://ec.europa.eu/docsroom/documents/48156>
- European Commission, (2022), Circular Procurement, On line at: https://ec.europa.eu/environment/gpp/circular_procurement_en.htm
- Falocco S., Le Donne G., Minutolo A., Mancini M., (2022), The Numbers of Green Public Procurement in Italy - 2022 Report, (in Italian), 44, On line at: https://www.legambiente.it/wp-content/uploads/2021/11/Green-Public-Procurement_report2022.pdf
- Fiorino D.J., (2010), Sustainability as a conceptual focus for public administration, *Public Administration Review*, **70**, 78-88.
- Fuentes Bagues J.L., Piccirillo E., Rebaudengo M., (2021), *Green Public Procurement of building works in the Piedmont Region of Italy*, 25th International Congress on Project Management and Engineering Alcoi, 6-9 July, Spain.
- Grandia J.J., Kruyen P.M., (2020), Assessing the implementation of sustainable public procurement using quantitative text-analysis tools: a large-scale analysis of Belgian public procurement notices, *Journal of Purchase and Supply Management*, **26**, 100627, <https://doi.org/10.1016/j.pursup.2020.100627>.
- Hall P., Lofgren K., Peters G., (2015), Greening the street-level procurer: challenges in the strongly decentralized Swedish system, *Journal of Consumer Policy*, **39**, 467-483.
- Hermundsdottir F., Aspelund A., (2021), Sustainability innovations and firm competitiveness: a review, *Journal of Cleaner Production*, **280**, 124715, <https://doi.org/10.1016/j.jclepro.2020.124715>.
- ISO 15686-5:2017, (2017), ISO 15686-5:2017 Buildings and constructed assets — Service life planning — Part 5: Life-cycle costing, On line at: <https://www.iso.org/standard/61148.html>
- Laurian L., Crawford J., (2016), Sustainability in the USA and New Zealand: explaining and addressing the implementation gap in local government, *Journal of Environmental Planning Management*, **59**, 2124-2144.
- Legambiente (2021), City Climate Report 2021 - "the climate has already changed" (in Italian: Rapporto Citta' Clima 2021 - "il clima e' gia' cambiato"), <https://www.legambiente.it/rapporti/rapporto-cittaclima/>.
- Li L., Geiser K., (2005), Environmentally responsible public procurement (ERPP) and its implications for integrated product policy (IPP), *Journal of Cleaner Production*, **13**, 705-715.
- Litardi I., Fiorani G., Alimonti D., (2020), *The State of the Art of Green Public Procurement in Europe: Documental Analysis of European Practices*. In: *Accountability, Ethics and Sustainability of*

- Organizations. *New Theories, Strategies and Tools for Survival and Growth*, Brunelli S., Di Carlo E. (Eds.), Springer, Cham, 175-192.
- Liu J., Ma Y., Apolloni A., Cheng W., (2021), How external stakeholders drive the green public procurement practice? An organizational learning perspective, *Journal of Public Procurement*, **21**, <http://dx.doi.org/10.1108/JOPP-04-2020-0035>.
- Liu J., Shi B., Xue J. Wang Q., (2019a), Improving the green public procurement performance of Chinese local governments: From the perspective of officials' knowledge, *Journal of Purchasing and Supply Management*, **25**, 100501, <https://doi.org/10.1016/j.pursup.2018.05.002>.
- Liu J., Xue J., Yang L., Shi B., (2019b), Enhancing green public procurement practices in local governments: Chinese evidence based on a new research framework, *Journal of Cleaner Production*, **211**, 842-854.
- Ma Y., Liu Y., Apolloni A., Liu J., (2021), Does green public procurement encourage firm's environmental certification practice? The mediation role of top management support, *Corporate Social Responsibility and Environmental Management*, **28**, 1002-1017.
- Marucci L., Iraldo F., Daddi T., (2021), Investigating the management challenges of the EU Ecolabel through multi-stakeholder surveys, *International Journal of Life Cycle Assessment*, **26**, 575-590.
- Marucci L., Daddi T., Iraldo F., (2019), The integration of circular economy with sustainable consumption and production tools: Systematic review and future research agenda, *Journal of Cleaner Production*, **240**, 118268, <https://doi.org/10.1016/j.jclepro.2019.118268>.
- MITE, (2007), Action Plan for Environmental Sustainability of Consumption in the Public Administration Sector, (in Italian), On line at: https://www.mite.gov.it/sites/default/files/archivio/alle_gati/GPP/all.to_19_PAN_GPP_definitivo_21_12_20_07.pdf
- MITE, (2017), National Action Plan on GPP, (in Italian), On line at: <https://gpp.mite.gov.it/Home/PianoAzioneNazionaleGPP>
- MITE, (2022), CAM - Minimum Environmental Criteria, (in Italian), On line at: <https://gpp.mite.gov.it/Home/Cam#3>
- MITE, (2023), Definition of minimum environmental criteria prior to the adoption of the relevant ministerial decrees, for the year 2023, (in Italian), On line at: https://gpp.mite.gov.it/sites/default/files/2023-04/DD_CAM_protocollato_MASE_EC_REGISTRO_DECRETI%28R%29_0000015.31-03-2023.pdf
- Navarani V., Zeeda F.M., Santha C., (2020), A systematic review of barriers impeding the implementation of government green procurement, *Journal of Public Procurement*, **20**, 451-471.
- Nucci B., Iraldo F., De Giacomo M.R., (2016), The relevance of life cycle costing in green public procurement, *Economics and Policy of Energy and the Environment*, **2016**, 91-109.
- Querol A.A., Schaefer B., Esquerrà i Roig J., (2020), *LCC and GPP - Competing or complementary approaches?* In: *The Challenges of Public Procurement Reforms*, 1st Edition, Routledge, 16.
- Rizzi F., Frey M., Testa F., Apolloni A., (2014), Environmental value chain in green SME networks: The threat of the Abilene paradox, *Journal of Cleaner Production*, **85**, 265-275.
- Rodriguez-Plesa E., Dimand A.M., Alkadry M.G., (2022), Community social capital, political values, or organizational capacity? Indicators of engagement in sustainable public procurement at the local level, *Journal of Cleaner Production*, **338**, 130556, <https://doi.org/10.1016/j.jclepro.2022.130556>.
- Testa F., Iraldo F., Frey M., Daddi T., (2012a), What factors influence the uptake of GPP (green public procurement) practices? New evidence from an Italian survey, *Ecological Economics*, **82**, 88-96.
- Testa F., Iraldo F., Frey M., Daddi T., (2012b), What factors influence the uptake of GPP (green public procurement) practices? New evidence from an Italian survey, *Ecological Economics*, **82**, 88-96.
- Testa F., Eleonora A., Iraldo F., Fray M., (2016a), Drawbacks and opportunities of green public procurement: An effective tool for sustainable production, *Journal of Cleaner Production*, **112**, 1893-1900.
- Testa F., Grappio P., Gusmerotti N.M., Iraldo F., Fray M., (2016b), Examining green public procurement using content analysis: existing difficulties for procurers and useful recommendations, *Environmental Development and Sustainability*, **18**, 197-219.
- Thomson J., Jackson T., (2007), Sustainable procurement in practice: lessons from local government, *Journal of Environmental Planning and Management*, **50**, 421-444.
- Wang Q., Wang S., Zhang M., Bu Z., Liu J., (2021), Green public procurement as a promoter for green consumption: From the perspective of individual's knowledge, *Cleaner and Responsible Consumption*, **3**, 100035, <https://doi.org/10.1016/j.clrc.2021.100035>.
- Wang Q., Zhang R., Liu J., (2020), Price/time/intellectual efficiency of procurement: Uncovering the related factors in Chinese public authorities, *Journal of Purchasing and Supply Management*, **26**, 100622, <https://doi.org/10.1016/j.pursup.2020.100622>.
- XPRESS, (2022), Facilitating green public procurement in the energy sector, On line at: <https://www.xpress-h2020.eu/digital-brochure-of-xpress-project.pdf>
- Ye M., Ma Y., Liu J., (2022), Why do public sectors perform high-level green public procurement practice? A new insight with fsQCA approach, *Journal of Environmental Planning and Management*, **65**, 2719-2747.