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The Interplay of Climate Change and Public Financial Management: Greening Public Procurement

Authors: Alma Ramsden and Antonia Ida Graf

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Abstract

This paper investigates the interlinkages between public financial management (PFM) and climate change by focusing on greening public procurement (PP). The research focuses on the role of the PFM environment in mainstreaming green considerations into public procurement to ensure government spending contributes to reductions in CO₂ emissions. To this end, three features of the PP function are examined – its form of organization (degree of centralization), operation mode (e-procurement), and financial conduct (Life Cycle Costing methods). For this purpose, extensive desk research and interviews with relevant stakeholders in three selected case study countries (The Netherlands, Austria, and South Korea) were conducted.

The study first reveals that a certain degree of centralization is necessary to mainstream environmental considerations into the PP function and institutionalize GPP. Second, e-procurement is seen as an effective enabler for including horizontal policy goals, such as environmental considerations, in the PP function. Third, although LCC can be helpful, it is not considered crucial for greening.

The following key success factors for greening PP can be derived from this research: The GPP endeavor should be planned along with the various steps of administrative reforms. Merely applying tools without a proper implementation process will not lead to success. Any modification to the PP system should be addressed through a comprehensive change process inclusive of all relevant stakeholders and the whole supply chain. A shift in paradigm concerning greening PFM practice as a whole, allowing for climate-informed decision making, is necessary. This requires embracing a holistic approach and considering a greening of the whole PFM cycle by implementing measures that help generate information on negative environmental externalities caused by public sector activities as well as on the financial and other impacts of climate change on public finances.

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The Interplay of Climate Change and Public Financial Management: Greening Public Procurement

Prepared for PEFA (a partnership program of the European Commission, International Monetary Fund, World Bank, and the governments of France, Luxembourg, Norway, Slovak Republic, Switzerland, and United Kingdom)

Prepared by

Alma Ramsden and Antonia Ida Grafl

Institute of Applied Management, School of Management and Law,
Zurich University of Applied Sciences, Zurich, Switzerland

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Abbreviations

AI	Artificial Intelligence
BBG	<i>Bundesbeschaffung</i> , Austrian Federal Procurement Agency
BMF	Federal Ministry of Finance, Austria
BMK	Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation, and Technology, Austria
CF	Carbon footprint
CO ₂	Carbon dioxide
EU	European Union
GDP	Gross Domestic Product
GPP	Green Public Procurement
ICLEI	Local Governments for Sustainability and Public Procurement Analysis
IFMIS	Integrated Financial Management Information System
KEITI	Korea Environmental Industry and Technology Institute
KGPN	Korea Green Purchasing Network
KIP	Korea Institute of Procurement
KONEPS	Korea ON-line E-Procurement System
LCA	Life Cycle Analysis
LCC	Life Cycle Costing
NAP	National Action Plan
ÖBS	ÖkoBeschaffungsService, Austria
OECD	Organisation for Economic Co-operation and Development
PEFA	Public Expenditure and Financial Accountability
PFM	Public Financial Management

PIANoo	Professional and Innovative Tendering Network for Government Contracting Authorities
PMIS	procurement management information system
PP	Public Procurement
PPS	Public Procurement Service
RVO	The Netherlands Enterprise Agency
RWS	Rijkswaterstaat, the Netherlands
SKAO	Foundation for Climate Friendly Procurement and Business, the Netherlands
SPP	sustainable public procurement
TCO	Total cost of ownership
UN	United Nations
UNEP	United Nations Environment Programme

Executive summary

This study investigates the links between the public financial management (PFM) system and climate change by focusing on greening public procurement (PP). PP is an element of budget execution and, as such, a subsystem of the PFM cycle. It also investigates the role of the PFM environment in mainstreaming green considerations into public procurement so that government spending can contribute to a reduction in carbon dioxide (CO₂) emissions. The existence of structural obstacles indicates the need for technical interventions to optimize the PFM environment in order to absorb greening reforms in PP better and more effectively. Hence, the focus is on identifying enablers for greening PP by looking through the PFM lens. To this end, the study examines three features of the PP function: form of organization, operational mode, and financial conduct. An extensive desk research and 19 interviews were conducted with stakeholders in three case study countries: Austria, the Republic of Korea, and the Netherlands.

First, the study analyzes the potential of green public procurement (GPP) measures to reduce CO₂ emissions, finding that the effects of GPP measures on CO₂ emissions cannot be quantified and compared easily due to differences in the methodologies applied and disparities between economic sectors and the design of GPP policies. Nevertheless, there is ample evidence that GPP has significant potential to reduce CO₂ emissions. This potential results, among others, from the sheer volume of public sector purchases and a government's predisposition to lead the way in greening: governments can display their willingness to go green by taking risks in the form of paying more for eco-friendly products, applying innovative technology, providing subsidies or grants for greening measures throughout the supply chain, and combining green targets with other sustainability objectives to reap the benefits of mutual reinforcement. Despite a significant uptake of general environmental considerations and green principles in PP, a gap is evident between the GPP legal framework and actual implementation in many countries, even in economies that have developed GPP through the enforcement of legislation.

Second, the study investigates the implementation gap and its causes, finding that most countries have GPP policies and targets in place, but their corresponding actions at the national or subnational levels lag behind and their policies and targets have not been met (GPP gap countries). A second group of countries does not yet have a GPP legal framework in place and has no or very

few GPP targets (basic GPP countries). A third group—the minority of countries—has a high level of GPP implementation, meaning that they meet the majority of their GPP targets and their actions at the national and subnational levels correspond closely to their GPP legal framework (advanced GPP countries). Various barriers and hurdles to successful GPP implementation are identified, indicating the need for technical interventions to address perceived or actual higher purchase prices, unfavorable surrounding conditions, and structural obstacles related to the nature of administrative reforms.

The finding of an implementation gap between the GPP regulatory framework and GPP practice leads to the central research question: Whether and how can elements of the PFM system address the implementation challenges and contribute to closing the implementation gap? Preliminary research suggests that three enablers within the PFM system can play a pivotal role in this regard: centralized procurement arrangements, electronic procurement (e-procurement), and life cycle costing (LCC). The in-depth exploration of these three enablers reveals the following:

- A certain degree of centralization is necessary to mainstream environmental considerations into the PP function and to institutionalize GPP since such strategic public procurement requires a structured, coordinated approach on the part of all institutions affected. Furthermore, centralized PP structures enable a pooling of knowledge, a professionalization of GPP, and an increase of market power to steer production toward sustainability.
- E-procurement is an effective enabler for including horizontal policy goals, such as environmental considerations, in the PP function. Automation makes public procurement more efficient, especially in the formal, more administrative phases, such as tendering and award. This efficiency frees resources to strengthen the more qualitative tasks of pre- and post-tendering, the phases of PP that contribute significantly to buying green as opposed to simply greening the process itself.
- Conventional LCC in the spirit of a total cost of ownership (TCO) approach only makes sense in the context of GPP for product groups that have follow-up costs, which is where financial gains over the life cycle of a sustainable purchase can be shown. However, the purchase price for greener solutions might still be higher, requiring more budgetary means in the short run. This higher price needs to be either accepted by procurers or priced into the budget allocation decision. Thus, although LCC can be helpful, it is not crucial for greening.

This study is intended not only to foster an academic debate on the interlinkages between PFM and climate change but also to provide a basis for tangible, universally applicable policy recommendations for governments to equip themselves better for the evolving environmental challenges. The following factors are found to be key for greening PP.

The GPP endeavor should be planned along the various steps of administrative reform. Merely applying tools without a proper process of implementation will not lead to success. Any modification of the PP system should be addressed through a comprehensive change process that

includes all relevant stakeholders and the entire supply chain, as GPP must be introduced in tandem with markets and be met with goodwill and conviction by buying institutions.

Moreover, GPP cannot be a singular measure if a government's ultimate goal is to reduce its CO₂ emissions. A shift in paradigm with respect to greening PFM practice as a whole and allowing for climate-informed decision-making is necessary. This shift requires embracing a holistic approach and considering greening the whole PFM cycle by implementing measures that help to generate information on the negative environmental externalities caused by public sector activities as well as the financial and other impacts of climate change on public finances.

1. Introduction

Under the 2015 United Nations (UN) Paris Agreement, 196 parties recognized the “need for an effective and progressive response to the urgent threat of climate change” and acknowledged that “climate change is a common threat to humankind” (UN 2015). The 2019 emissions gap report of the United Nations Environment Programme (UNEP) assesses the levels of current and estimated future greenhouse gas emissions, of which carbon dioxide (CO₂) is the most abundant. It concludes that by 2030, “Emissions would need to be 25 percent and 55 percent lower than in 2018 to put the world on the least-cost pathway to limiting global warming to below 2°C and 1.5°C, respectively” (UNEP 2019a, 5). Decisive action to reduce greenhouse gas emissions globally is urgently needed.

In order to achieve sustainability, a deep-rooted transformation of societies, economies, infrastructures, and governance institutions is required. The Coalition of Finance Ministers for Climate Action,¹ a group of finance ministers committed to combating climate change, recognized the unique potential of public financial management (PFM) to address and manage challenges stemming from global warming by providing adaption as well as mitigation tools through the PFM system. The Helsinki Principles, which serve as guidance for coordinated action of the coalition, explore, among others, the integration of eco-friendly aspects into the guidance, procedures, and methodologies for public procurement.

This study analyzes how climate change considerations can be mainstreamed into the public procurement process so that government spending can serve as a lever for green growth and ultimately contribute to a reduction in CO₂ emissions. In doing so, the public procurement (PP) function is viewed through the PFM lens to investigate which PFM tools enable the greening of the public procurement system.

1.1. What is (green) public procurement?

Public procurement is “the area of public administration concerned with the acquisition by the government of goods, works, and services from the marketplace” (Sanchez 2013). It is an operational function of government and an element of budget execution; as such, it is a subsystem

¹ See, for example, https://www.cape4financeministry.org/coalition_of_finance_ministers.

in the PFM cycle. In the Public Expenditure and Financial Accountability (PEFA) framework for public procurement, indicator PI-24 covers government spending on goods, services, civil works, and major equipment investments. An efficient procurement system “ensures that money is used effectively in acquiring inputs for, and achieving value for money in, the delivery of programs and services by a government” (PEFA Secretariat 2019, 67).

The administration of PP varies between countries and can be a national, provincial, or district-level responsibility or a combined responsibility. Public procurement is considered a critical link between expenditure management and the attainment of a government’s broader economic and social objectives (Sanchez 2013). In recent years, several horizontal policy goals have come into play, including sustainability considerations such as environmental objectives (Handler 2015).

There is no uniform definition of green public procurement (GPP); in particular, there is no clear definition of what “green” constitutes. The majority of descriptions of GPP are rather broad and highlight the importance of replacing “standard” products with “more environmentally friendly” ones. For example, the European Commission states that GPP refers to “a process whereby public authorities seek to procure goods, services, and works with a reduced environmental impact throughout their life cycle when compared to goods, services, and works with the same primary function that would otherwise be procured” (EC and ICLEI 2016). Some definitions highlight the importance of public finance in greening the public procurement function; for example, according to the Korea Institute of Procurement (KIP), GPP is “a series of purchasing systems for products, services, and construction through public finance with the purpose of minimizing the possible negative impact of its required resources and energy on people, environment, and earth” (RK04).²

Given the absence of a common definition and therefore the absence of common standards for calculating GPP, indicators describing what targets and goals have already been achieved by governments in terms of implementing green criteria play a crucial role in monitoring GPP. There are many indicators, and they differ between countries, including, for example, the number of items procured that include green criteria, the economic volume of items procured that include environmental criteria, the uptake of total cost of ownership (TCO) analysis, expenditure on eco-labeled products, and share of the government budget spent on green items (UNEP 2017b).

In addition, national states and supranational organizations have developed various tools and criteria to measure and promote greening in public procurement. Under the 2014 Procurement Directives of the European Union (EU), all procurement contracts must be awarded to the most economically advantageous tender, an approach that makes it possible for the procurer to award and compare factors beyond price, such as quality and sustainability (EC 2017). Furthermore, the concept of circular procurement for achieving GPP has gained increased attention in recent years. Circular procurement refers to “the purchase of works, goods, or services that seek to contribute to the closed energy and material loops within supply chains, whilst minimizing, and in the best case avoiding, negative environmental impacts and waste creation across the whole life cycle” (EC 2017). Furthermore, the EU has developed “clear, verifiable, justifiable, and ambitious

² Green public procurement is not the same as sustainable public procurement, although these two concepts are often used synonymously. Sustainable public procurement refers to “a process by which public authorities seek to achieve the appropriate balance between the three pillars of sustainable development—economic, social, and environmental—when procuring goods, services, or works at all stages of the project” (EC n.d.-c).

environmental criteria for products and services, based on a life cycle approach and scientific evidence base” and, since 2008, has developed more than 20 common GPP criteria to facilitate the inclusion of green requirements in public tender documents (EC n.d.-a). GPP criteria can be formulated as selection criteria (criteria that refer to the selection of the tenderer), technical specifications (minimum compliance requirements that all tenders must meet), award criteria (criteria that refer to everything that is evaluated and scored for award purposes), or contract performance clauses (clauses that are used to specify how a contract must be carried out).

Moreover, ISO Standard 20400 is directed toward public procurement and provides guidance on how to integrate sustainability into the procurement process and into organizations’ procurement policies and strategies (ISO n.d.). Several countries have developed their own eco-labels and certification systems, such as the Republic of Korea (RK02).

In sum, awareness of GPP’s potential is growing, and efforts to implement it are increasing. However, additional political stimulus will be needed if GPP is to become more accepted internationally. Until then, GPP remains a largely underexposed subject, as outlined in the next section.

1.2. Research questions and hypotheses

Although green public procurement has received increasing attention over the past decade, few research papers have covered this topic (Testa et al. 2016), and sustainability considerations have not yet been fully integrated into procurement processes (UNEP 2017b). In addition, the existence of structural obstacles indicates the need for technical interventions.

This study investigates how the PFM environment can help to establish green considerations in public procurement so that government spending can contribute to a reduction in CO₂ emissions. The focus lies on identifying prerequisites for greening PP by looking through the PFM lens. In search of concrete enablers within the PFM system, three features of the PP function are examined: form of organization, operational mode, and financial conduct. This broader systemic approach has not been taken before, and the relevance of these aspects for GPP is underexplored. This study is structured around three research questions, which are outlined next.

1.2.1. Research question 1: Can public procurement contribute to the reduction of CO₂ emissions?

Few areas of government influence the private sector as directly as public procurement or have the potential to change patterns of production and consumption. For this reason, governments can contribute to local, regional, national, and international sustainability goals by using their purchasing power to choose goods, services, and works with a smaller environmental impact (EC and ICLEI 2016). Examining the size of this potential in terms of its quantitative impact on CO₂ emissions leads to the first hypothesis (H1): *GPP has the potential to curb CO₂ emissions.*

1.2.2. Research question 2: Is there an implementation gap between the GPP regulatory framework and GPP practice?

The global uptake of environmental considerations and green principles in PP is significant. Nevertheless, legally binding measures are rare, and the depth and rigor of criteria vary widely (APEC 2013; EU 2012). Moreover, even economies that have developed GPP through the enforcement of legislation are often faced with a gap between conceptual and actual implementation (APEC 2013)—that is, a gap between GPP policies and actions performed at national and subnational levels by procurement and other government officials (EC and ICLEI 2016). Investigating the presence of the implementation gap and its causes in the form of hurdles and barriers to GPP leads to the second hypothesis (H2): *There is an implementation gap between the GPP regulatory framework and GPP practice.*

1.2.3. Research question 3: How can the PFM system contribute to closing the implementation gap and greening PP?

The PFM environment has a role to play in greening the public procurement function, as certain systemic preconditions are crucial in order to mainstream eco-friendly considerations successfully into PP. The PFM system may help to overcome implementation barriers in relation to the organizational, operational, and financial conduct of public procurement. Examining three distinct enablers within the PFM system that might facilitate an uptake of GPP practice leads to the third hypothesis (H3): *centralized procurement (H3a), e-procurement (H3b), and life cycle costing (H3c) can facilitate the uptake of GPP practice.*

1.3. Structure of this paper

This paper is structured as follows: Section 2 explains the methodologies chosen to explore the three hypotheses. Section 3 investigates the potential of GPP to reduce CO₂ emissions. Section 4 examines the implementation gap and identifies the main hurdles to implementing GPP. Section 5 describes the enablers of the PFM system and how they help to address these barriers. Section 6 presents the main findings and offers concrete policy recommendations. Section 7 concludes. Appendix A provides information on the interviews conducted. Appendix B describes studies quantifying the effect of GPP measures on CO₂ emissions. Appendix C details GPP uptake by country.

2. Methodology

GPP is an interdisciplinary area, and this study takes a collaborative approach to studying it by complementing desk research with expert knowledge gained through interviews in three case study countries: Austria, Korea, and the Netherlands.

2.1. Desk research

In the desk research, existing literature was reviewed and data on all aspects related to the research questions were gathered to develop the hypotheses, select countries for case studies, and lay the groundwork for developing the questionnaire used to interview stakeholders. Papers from peer-reviewed journals as well as publications from both government and nongovernment organizations were reviewed. After the case study countries were selected, publications and internal documents were reviewed to gain a deeper understanding of GPP in the case study countries.

2.2 Case studies

The three case studies were conducted to validate the hypotheses, identify good practices in GPP, and ultimately derive policy recommendations on how the PP function can be greened in order to reduce CO₂ emissions.

The desk research focused on finding countries whose PFM environment and hence GPP measures offer promising solutions to overcome the implementation gap. Austria, Korea, and the Netherlands were selected because they are considered forerunners in green public procurement (UNEP 2019b) and serve as models of good practice for other countries. Moreover, their governments have been committed to GPP for a considerable time. This commitment is important for obtaining conclusive information on the success factors and limitations of GPP functions and for determining how they interrelate with the general PFM system. Given that the study takes a functional perspective—that is, it focuses on elements of the PFM system that facilitate GPP—focus was placed on the PFM environment rather than on factors such as level of economic development. For the same reason, no attempt was made to achieve a balanced mix of developing and developed countries. The intention was to identify what countries at a nascent stage of implementing GPP can learn from the successes, failures, and challenges of economies at an advanced stage of GPP implementation.

Following the selection of sample countries, semistructured interviews were conducted with experts from government and nongovernment organizations involved in GPP. Each questionnaire consisted of a standardized part to compare GPP practices across the three countries and a flexible part to capture country-specific aspects as well as the institutional setting. The inductive approach was complemented with a deductive approach: in addition to testing the hypotheses and identifying good practices and challenges in GPP implementation, the aim was to identify relevant issues to be explored in the context of GPP. Table 1 provides an overview of which country case study serves to investigate which hypothesis.

Table 1: Validating the hypothesis through country case studies

Country	H1	H2	H3a	H3b	H3c
Netherlands, the	P	P	P	X	P
Austria	(P)	P	P	(P)	(P)
Korea, Rep.	(P)	P	(P)	P	X

Note: P = can be investigated. (P) = can be partly investigated. X = cannot be investigated.

2.3.1. Case study 1: The Netherlands

The Netherlands is a leader in applying environmental criteria and is considered one of the seven best-performing EU member states with respect to GPP (Hasanbeigi, Becqué, and Springer 2019; PricewaterhouseCoopers, Significant, and Ecofys 2009). Furthermore, the country has designed practical tools and structures to promote GPP (box 1). The CO₂ performance ladder is a management system that contracting authorities can use to analyze CO₂ emissions and to identify and implement reduction actions; it is also a procurement tool that stimulates suppliers and contractors to do the same. DuboCalc is a tool for calculating the environmental impact of infrastructure projects (TN01; TN03). Furthermore, in 2005 the Professional and Innovative Tendering Network for Government Contracting Authorities (PIANOO) was established to professionalize procurement and tendering in all government departments. PIANOO consists of a network of around 3,500 public procurement and tendering professionals. It pools knowledge and experience in the area of PP and GPP, provides advice to relevant stakeholders, and fosters dialogue between government contracting authorities and private sector companies.

Box 1: Select tools and organizations used to facilitate the implementation of green public procurement in the Netherlands

CO₂ performance ladder

The CO₂ performance ladder is a certification system based on life cycle analysis (LCA) that helps (public and private) organizations to reduce their carbon emissions. It is used as both a management system and a procurement tool, helping organizations to gain insight into, and cut down on, their CO₂ emissions and receive an award advantage, with higher scores leading to a greater advantage in the tendering process. Both contracting authorities and organizations can use the CO₂ performance ladder when drawing up tender notices.

DuboCalc

DuboCalc is used to calculate the environmental costs of procurement. It calculates the effects of material and energy use from extraction to demolition and recycling, resulting in an environmental cost indicator that considers all relevant environmental impacts throughout the entire life cycle. The method is based on LCA. DuboCalc is intended to achieve significant environmental benefits in the design, performance, and tenders for civil engineering works.

PIANOO (Professional and Innovative Tendering Network for Government Contracting Authorities)

PIANOO was established to professionalize public procurement; it works for and with a network of around 3,500 public procurement and tendering professionals. It is an expertise center that brings together experts, pools knowledge and experience, and provides advice to and fosters dialog between government contracting authorities and private sector companies (PIANOO 2019). It also houses working groups and conducts procurement training (EC and ICLEI 2016).

Sources: EC and ICLEI 2016; Rietbergen, van Rheede, and Blok 2015; SKAO 2020; see also <https://www.pianoo.nl/en/about-pianoo-0>; <https://www.dubocalc.nl/en/what-is-dubocalc/>; and <https://www.skao.nl/en/what-is-the-ladder>.

The Netherlands case study offers practical tools that help to promote GPP, which enables the analysis of hypothesis H1 (GPP has the potential to curb CO₂ emissions) and hypothesis 3c (LCC is an enabler within the PFM system that facilitates the implementation of GPP). It also allows us to investigate hypothesis H2 (there is an implementation gap between the GPP regulatory

framework and actual GPP practice). Given the legally decentralized procurement structure in the Netherlands (TN03), it is also possible to gain insights into hypothesis 3a (centralized procurement arrangements are enablers within the PFM system that facilitate the implementation of GPP).

Interviews were held with representatives from the following organizations:

- The Foundation for Climate Friendly Procurement and Business (SKAO), which develops, owns, and manages the CO₂ performance ladder
- The Netherlands Enterprise Agency (RVO), which is part of the Ministry of Economic Affairs and Climate Policy and assists businesses in becoming more sustainable, among other tasks
- The Professional and Innovative Tendering Network for Government Contracting Authorities (PIANOo), described in box 1
- Rijkswaterstaat (RWS), which is part of the Dutch Ministry of Infrastructure and Water Management and developed DuboCalc
- Copernicus Institute of Sustainable Development, Sustainable Development Expertise Center, Utrecht University.

2.3.2. Case study 2: Austria

Austria has implemented GPP at the federal level and frequently serves as an international good-practice example. In 2010 the government adopted a National Action Plan (NAP) for sustainable public procurement (naBe-Aktionsplan), covering goals and measures for sustainable public procurement (SPP)³ as well as environmental criteria for products from 16 product groups (OECD 2015; AU02). The NAP is mandatory for the federal level and serves as baseline for other levels of government, although some regions have even more ambitious green criteria than the federal state. The NAP is being updated in 2021 to put greater weight on GPP, and the scope of product groups is being extended. The Organisation for Economic Co-operation and Development (OECD) has recognized Austria as a leading example with respect to its legal and policy framework, environmental standards in procurement, professionalization of GPP, awareness-raising activities, and monitoring (OECD 2015).

The organizational structure of the procurement function has important implications for greening public procurement. In particular, a distinction can be drawn between decentralized and centralized purchasing. Decentralized public procurement describes a process whereby a procurement organization, in the absence of a central or controlling authority, is authorized to adopt purchasing decisions individually within the legal and regulatory framework. Centralized public procurement combines the procurement activities of at least two contracting authorities, which can eventually culminate in demand aggregation. Such joint procurement as well as decentralized arrangements

³ Sustainable public procurement, of which GPP is a subcategory, is an umbrella definition comprising social as well as environmental aspects.

do not indicate administrative aspects and may occur at the federal, regional, and municipal levels (Albano and Sparro 2010; EC 2008; Glas, Schaupp, and Essig 2017).

The Austrian approach explicitly takes into account the country's federal structure and fosters close collaboration between all levels of government. The Austrian Federal Procurement Agency (BBG) is the centralized procurement body responsible for implementing the NAP and has the mandate to support regions and municipalities through several channels, such as online platforms, brochures, and help desks via the naBe platform (AU02).

Joint procurement initiatives also exist at the municipal and regional levels, comprising both ad hoc and permanent arrangements (box 2). These initiatives yield convincing results regarding cost-effectiveness and eco-friendliness. One example is the ÖkoBeschaffungsService (ÖBS), founded for the specific purpose of conducting GPP for municipalities in the region of Vorarlberg (AU04).

Box 2: Information on two procurement agencies in Austria

BBG (Bundesbeschaffung)

BBG, the Austrian Federal Procurement Agency, is the central purchasing body for ministries, federal states, cities, and municipalities as well as for outsourced organizations, universities, and health care facilities. BBG is wholly owned by the federal government, represented by the Federal Ministry of Finance. BBG houses the naBe platform, supporting the National Action Plan for Sustainable Public Purchasing, which is mandatory for public entities at the federal level. The platform also serves as a competence center regarding GPP implementation.

ÖBS (ÖkoBeschaffungsService)

ÖBS is the regional purchasing body of the Vorarlberg Municipal Association. It supports municipalities and public entities based in the Austrian region of Vorarlberg to procure sustainably. The ÖBS offers products and services from more than 50 product groups and concludes framework contracts for its clients. The first set of sustainable criteria was drafted as early as 1999, but municipalities had difficulty implementing it. The ÖBS was established—almost simultaneously with the BBG at federal level—to address this problem and to conduct green procurement for the regional public sector.

Sources: AU02; AU04.

The Austria case study is useful for examining the extent to which the structure and organizational form of the procurement function affects GPP—that is, for validating hypothesis H3a (centralized procurement arrangements are enablers within the PFM system that facilitate the implementation of GPP) and, to a lesser extent, hypothesis H1 (GPP has the potential to curb CO₂ emissions) and hypothesis H2 (there is an implementation gap between the GPP regulatory framework and actual GPP practice).

Interviews were held with representatives from the following organizations:

- The Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), which is responsible for coordinating the NAP and represents the policy side
- The Federal Ministry of Finance (BBF), which is the sole shareholder of the BBG

- The Austrian Federal Procurement Agency (BBG), described in box 2
- The regional purchasing body of the Vorarlberg Municipal Association (ÖBS), also described in box 2.

2.3.3. Case study 3: Republic of Korea

Korea has a long and deep-rooted tradition of green public procurement, being one of the first countries to integrate GPP as a policy instrument (UNEP 2019b). The country offers “a convincing case for a clear and well-aligned [GPP] framework” (OECD 2015, 9). Furthermore, Korea is a frontrunner in using and linking electronic procurement systems and platforms for GPP implementation and monitoring (UNEP 2019b).

GPP was first introduced together with the Korea Eco-label Certification System in 1992 and has been booming since 2005, when the Act on Promotion of the Purchase of Green Products came into force (Lee n.d.). The Eco-label system is fundamental to Korea’s GPP function, and it has contributed greatly to its development (RK03), because the GPP focus is on purchasing green products, which are certified through one of three certification systems (Korea Eco-label, Good Recycled Mark, and Carbon Footprint of Products) (RK05).

Korea’s Public Procurement Service (PPS) is in charge of procurement for central governments and several public institutions that are subject to the Act on Contracts to Which the State Is a Party (RK02). Individual public institutions can only manage the purchase and tendering process through their own procurement systems for purchases below certain thresholds. In addition, each local government has its own procurement department and procurement officer (RK05). Korea has a strong institutional framework for GPP implementation, as GPP is based on the collaboration of four key agencies: the Ministry of Environment, the Korea Environmental Industry and Technology Institute (KEITI), the Ministry of Economy and Finance, and the PPS (UNEP 2019).

Korea is one of the few countries with a well-established, well-functioning e-procurement system: KONEPS, the Korea Online E-Procurement System. More than 70 percent of Korea’s total public procurement and 80–90 percent of GPP are conducted through KONEPS (Kang 2018; RK02). The system is highly recognized globally and is a benchmark for many developing countries (RK06). Box 3 provides information on Korea’s public procurement institutions.

Including Korea as a case study is useful for investigating hypothesis H3a (centralized procurement arrangements are enablers within the PFM system that facilitate the implementation of GPP) and hypothesis H3b (e-procurement solutions are enablers within the PFM system that facilitate the implementation of GPP). To a lesser extent, it is also relevant to hypothesis H1 (GPP has the potential to curb CO₂ emissions) and hypothesis H2 (there is an implementation gap between the GPP regulatory framework and actual GPP practice).

Box 3: Public procurement institutions in the Republic of Korea

KEITI (Korea Environmental Industry and Technology Institute)

Affiliated with the Ministry of Environment, KEITI operates the overall green public procurement (GPP) system and the Korea Eco-label. It is a quasi-governmental organization, contributing to the improvement of environmental welfare services and sustainable national development by developing and supporting environmental technology, fostering the environmental industry, and spreading eco-friendly life. KEITI was designated as a dedicated management agency in the Act on Promotion of the Purchase of Green Products in order to manage and implement GPP systemically. KEITI receives data on purchases submitted by the heads of public institutions, provides information on green products, and trains procurers to promote GPP.

PPS (Public Procurement Service)

PPS is the central public procurement agency in Korea. It facilitates the entry of green products into the public market, fosters public demand for green products, and expands green construction works for public buildings. It also manages and operates KONEPS.

KONEPS (Korea ON-line E-Procurement System)

KONEPS went live in 1997 and has been an integrated service for the entire procurement process since 2002, operated through a single portal. Developed from the perspective of the purchaser, KONEPS aggregates data, produces statistics, and analyzes results; it is primarily a management system. In addition to KONEPS, the electronic public procurement statistics system monitors the entire public procurement market in Korea and supports the implementation of procurement policies.

Sources: Kang 2018; RK02; KR06.

Interviews conducted by the Korean Institute of Public Finance were held with representatives from the following organizations:⁴

- Korea Green Purchasing Network (KGPN), a nonprofit private organization that promotes sustainable production and consumption and generates demand for green production
- Korea Environmental Industry and Technology Institute (KEITI), described on box 3
- Korea Institute of Procurement (KIP), an academic institute that conducts research on green procurement systems and policies
- Public Procurement Service (PPS), also described in box 3
- Local Governments for Sustainability and Public Procurement Analysis (ICLEI) Korea, which is part of ICLEI, a global network that promotes sustainability policy and drives local action for low-emission, nature-based, equitable, resilient, and circular development.

⁴ For information on these organizations, see <https://iclei.org>; <http://www.igpn.org/about/index.html>; OECD 2015; and oneplanetnetwork.org.

- Ministry of Environment, which is in charge of GPP and implemented the Act on Development and Support of Environmental Technology of 1994, which introduced GPP in the country.

3. Quantitative impact of GPP on CO₂ emissions

Authorities who implement GPP will be better equipped to meet evolving environmental challenges, for example, to reduce greenhouse gas emissions or move towards a more circular economy (EC and ICLEI 2016).

3.1. Development of the hypothesis

Governments around the globe are major consumers: on average, 12 percent of global gross domestic product (GDP) is spent on public procurement (Bosio and Djankov 2020). Through the purchase of products and services with a lower carbon footprint, public authorities thus have the power to reduce greenhouse gas emissions (EC 2020a). For example, PricewaterhouseCoopers, Significant, and Ecofys (2009) estimate that greening public procurement would reduce CO₂ emissions by 25 percent, on average, in seven European countries (Austria, Denmark, Finland, Germany, the Netherlands, Sweden, and United Kingdom) for the 10 product groups analyzed.

This fact leads to hypothesis H1: GPP has the potential to curb CO₂ emissions. In order to explore this hypothesis, it is necessary to quantify the potential impact of GPP on emissions. CO₂ is the focus because it is the most common greenhouse gas emitted by human activities, in terms of both the quantity released and the total impact on global warming (Brander 2012). Nevertheless, the literature review also covers studies that address two other types of emissions: greenhouse gases in general and CO₂ equivalents.⁵ This clarification is necessary because the terms “CO₂ emissions” and “greenhouse gas emissions” are often (erroneously) used synonymously.⁶

The term “green” is specified broadly for this analysis because there is no clear definition of “greening.” As a result, green public procurement can take many forms and be implemented in many products and services. The range of topics covered in the literature review includes, for example, measures taken within a certain product group or within a certain geographic area. For example, Cerutti et al. (2016) analyze the effect on greenhouse gas emissions of three food policies implemented in a school catering service in an Italian city. Their study analyzes a specific sector

⁵ Because CO₂ is considered the most important greenhouse gas, some assessments do not consider other greenhouse gases, which can understate the total impact on global warming. One way to circumvent this problem is to calculate CO₂ equivalents. CO₂ equivalents convert greenhouse gas emissions into a common unit, meaning the amount of CO₂ that would have the equivalent impact on global warming. This approach makes it easy to compare the various greenhouse gases to one another (Brander 2012).

⁶ Greenhouse gases trap heat in the atmosphere. They include carbon dioxide, methane, nitrous oxide, and fluorinated gases. CO₂ is the most abundant, constituting about 80 percent of all greenhouse gas emissions (EPA, United States n.d.).

(catering services for schools) in a narrow geographic area (an Italian city). With regard to sectoral analysis, many papers investigate measures in the food sector, the building and maintenance sector, and the transportation sector (vehicles).

Methodologically, most of the studies analyzed are based on life cycle analysis (LCA) or carbon footprint (CF), which is also a life cycle–based indicator. Both CF and LCA do more than measure the impact of GPP; they also are tools for implementing GPP. At the same time, it is important to distinguish between life cycle analysis and life cycle costing (LCC): LCA quantifies the environmental impact of a product’s manufacture, use, and end of life (Samaras and Meisterling 2008), while LCC estimates the total monetary costs over the life cycle of works, supplies, or services that are linked to a purchase (EU 2012; SIGMA Programme 2016, 2). CF addresses all emissions caused by consumption rather than production activity (Larsen and Hertwich 2010). Thus, CF focuses on just one category of environmental impact (greenhouse gas emissions), while LCA takes into account more categories of impact, such as land use, water use, and acidification (Agri Footprint 2020). The advantage of the CF tool is that it includes indirect emissions that occur in the value chain of the reporting company—that is, “scope 3” emissions.⁷

This study only covers papers that address the quantitative effect on CO₂ emissions of GPP measures that have already been implemented. It does not analyze the effects of measures that governments could adopt in public procurement or that have important implications for GPP practices, but have not been implemented. This distinction is important because many studies analyze measures that governments could implement to make public procurement greener, but that have not yet been implemented.⁸

3.2. Quantitative impact of GPP measures on CO₂ emissions

Few studies have quantified the impact of GPP measures on greenhouse gas emissions. According to Cheng et al. (2018), “GPP is not a well-trodden area of research ... and there is a lack of academic literature [on GPP].” Participants in the interviews also criticized the lack of reliable data (AU01; AU04; TN01 2021). Only 15 studies were found that measure the impact of GPP on emissions.⁹

Overall, greening public procurement can reduce greenhouse gases and CO₂ or CO₂ equivalents by between 3 percent and more than 90 percent. Given the differences in greening potential

⁷ The Greenhouse Gas Protocol Corporate Standard classifies a company’s emissions into three “scopes.” Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions. See https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf.

⁸ One example is the analysis by Cox and Bauer (2018), who study the environmental performance of different types of modern passenger cars using life cycle analysis. However, their analysis does not (at least, not yet) constitute a GPP measure in Switzerland.

⁹ The search was conducted with the following keywords: “green public procurement,” “public procurement,” “CO₂ emissions,” “greenhouse gas emissions,” “carbon footprint,” “life cycle analysis,” and any combination of these keywords. Most studies were from peer-reviewed journals, but papers from intergovernmental and international organizations were included in the search as well.

between economic sectors (TN04; TN05), a sectoral analysis of the quantitative impact of GPP on emissions was also undertaken.

These differences exist for two reasons. First, some sectors are easier to green than others (AU01). Based on monitoring results from Japan, sectoral differences are striking: savings range from 29 tons of CO₂ equivalents for workwear (the amount of energy that 2.5 homes use for one year)¹⁰ to 34,260 tons of CO₂ equivalents for LED lighting fixtures (the amount of energy that almost 4,000 homes use in one year) (UNEP 2019b). Second, the market power of the public sector varies by sector (AU02; AU03; TN03), as does its use to steer the supply side in a certain direction (TN04). It is difficult for governments to influence markets in sectors that are dominated by large or global private companies (AU02). However, the potential influence can be increased by combining different targets (TN04)—for example, social and green objectives (TN05)—or by putting in place certain structures, such as effective asset management in the construction sector (TN04).

3.2.1. Sectoral analysis of the quantitative impact

In the food sector, which is one of the most analyzed sectors, GPP can reduce emissions from around 8 percent overall (Cerutti et al. 2018) to more than 40 percent for food-cooling systems (Gröger, Stratmann, and Brommer 2015). Shifting to a vegetarian, local, or organic diet is a promising means of curbing emissions (see, for example, Cerutti et al. 2018; Jungbluth, Keller, and König 2016; Pulkkinen et al. 2016). However, the effects depend on the specific requirements. Organic or integrated production¹¹ reduces the carbon footprint associated with food production by 32 percent compared to conventional production, while requirements for regional provisioning of products reduce greenhouse gas emissions by 33 percent compared to the previous year (Cerutti et al. 2016); however, shifting from petrol motor vehicles to natural gas vehicles in urban food distribution does not reduce greenhouse gas emissions.¹²

In the maintenance and buildings sector, the potential emissions savings range from around 3 percent (Rietbergen and Blok 2013) to more than 50 percent (Trovato, Nocera, and Giuffrida 2020). The range for emissions savings in the transport sector (analyzed in three studies for four modes of transport) is even larger, from around 17 percent (Gröger, Stratmann, and Brommer 2015) to more than 90 percent (EC and ICLEI 2016). This wide range is due to the different modes of transport analyzed (passenger cars, buses, ferries, and construction machines). The quantitative impact of GPP on CO₂ emissions for lighting and electricity, analyzed in two studies, is 36 percent and 45 percent, respectively. The two studies that investigate GPP measures for cleaning materials report an emissions reduction of between 36 percent (Gröger, Stratmann, and Brommer 2015) and 70 percent (Ministry of the Environment, Denmark 2013).

¹⁰ Calculations based on the greenhouse gas calculator provided by the US Environmental Protection Agency (<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>).

¹¹ Integrated production is a knowledge-based approach to farming, based on maximizing natural control processes for pest and soil management and growing a healthy crop. It is a dynamic approach to move toward sustainable farming systems, introduced in steps up the integrated production “ladder.” See <https://www.pan-europe.info/campaigns/agriculture/integrated-production>.

¹² This is due to the high traction efficiency of petrol motors and the high particulate removal performance of new-generation filters (Cerutti et al. 2016).

Moreover, within a product or service group, the results can differ along the value chain. For example, Cerutti et al. (2016) find that policies affecting *production* practices have the greatest potential to reduce the carbon footprint of the catering sector, because 61 percent to 70 percent of the greenhouse gases are emitted in the production phase.

3.2.2. Other factors that determine quantitative impact

A sectoral approach is helpful for examining the quantitative impact of GPP on emissions. In addition, the scope of emissions analyzed is also relevant for determining the potential of GPP. In this regard, the research highlights the relevance of whether direct or indirect emissions along the value chain—that is, scope 3 emissions—are investigated (TN01). Alvarez and Rubio (2015), who analyze conservation and maintenance services, find that scope 3 emissions make up the largest source of emissions. Larsen and Hertwich (2010), who study emissions from municipal activities in Norway, estimate that only 5 percent of these emissions are direct emissions; the remaining 95 percent are indirect emissions (scope 2 and 3).

Another important factor concerns methodological aspects: quantifying the impact of GPP on emissions is challenging because of a lack of reliable data (AU01; AU05; RK02) and difficulty in estimating the causal effect of GPP on emissions due to confounding variables (Rietbergen and Blok 2013). Even where data are available, estimating how much a specific measure can reduce CO₂ emissions is complicated (TN01).

Another challenge when analyzing the potential for GPP to reduce CO₂ emissions is that the greenest way to procure is not to procure at all—that is, it is better to use procured products and services as long as possible.¹³ Circular procurement and total cost of ownership models can help to overcome this limitation because they take into account the entire life cycle of a product or service. At the same time, there is growing recognition of the importance of this aspect for both the demand and the supply sides (TN04).

Not least, the design of policies needs to be questioned, as is done by Rietbergen, van Rheede, and Blok (2015) and Rietbergen and Blok (2013), who assess the potential impact of the CO₂ performance ladder on the reduction of CO₂ emissions in the Netherlands. They find that companies do not set ambitious enough emissions reduction targets, implying that carbon counting is a powerful tool for reducing emissions only if combined with ambitious targets and the full commitment of relevant stakeholders.¹⁴ Jungbluth, Keller, and König (2016) confirm this finding, stating that carbon counting as a GPP instrument has a lot of potential in the agricultural stage of the food sector. Hence, if target levels for reducing corporate greenhouse gas emissions are not very ambitious and if the target-setting practice is neither very rigorous nor applied uniformly across companies, corporate emissions will not decline significantly.

¹³ Another common problem in the academic literature is that papers might be disregarded because they have not found the desired effect (that is, no impact of GPP on emissions).

¹⁴ However, this finding is not surprising because the tool is also a management system for reducing CO₂ emissions (TN02; TN03).

4. Gap between the GPP regulatory framework and actual GPP implementation

4.1. Development of the hypothesis

According to ICLEI, a global network of governments committed to sustainable development, a gap exists between GPP policies and the actions of national procurement officials, with many unaware of the full extent of national requirements (EC and ICLEI 2016). A UN report from 2017 also finds that sustainability considerations—including environmental (that is, green) considerations—have not yet been fully integrated in procurement processes. Instead, SPP—and hence GPP—is often the initiative of an individual department or government agency, resulting in a fragmented GPP landscape. In addition, the enforcement of SPP or GPP policies and the extent of effective monitoring vary between countries, influencing the implementation of environmental concerns (UNEP 2017b, vi–viii).

Some countries have high uptake of GPP, including the group of countries known as the Green-7,¹⁵ whose level of GPP uptake in 2006–07 was 45 percent of total procurement by value and 55 percent by volume (PricewaterhouseCoopers, Significant, and Ecofys 2009). By procurement value, the United Kingdom was the best-performing country at the time, with a level of GPP of 75 percent. By procurement volume, Austria scored the highest, at 62 percent. But even these countries have not fully greened their procurement functions, and countries at the other end of the spectrum have not yet laid the legal grounds for effective GPP implementation.

These preliminary findings lead to the second hypothesis (H2): there is an implementation gap between the GPP regulatory framework and GPP practice. The implementation gap is defined as the gap between the GPP regulatory framework and the actions performed at the national and subnational levels by relevant organizations and stakeholders (EC and ICLEI 2016). To test this hypothesis, GPP implementation was analyzed across 58 countries and product or service groups. For the 58 countries, GPP uptake as well as the policies addressing GPP and the targets set with regard to GPP were analyzed. This holistic approach was crucial given that “the policy environment is a primary factor that determines the extent of engagement in GPP” (Cheng et al. 2018), “mandatory policy frameworks for SPP are typically more effective in driving implementation” (UNEP 2017a), and “it is arguably easier to measure quantitative or ‘process’ indicators” (UNEP 2017a).

Finally, specific hurdles or barriers to GPP implementation and uptake were investigated to gain insight into the underlying mechanisms of the implementation gap and how they can be addressed by taking a PFM perspective.

¹⁵ The Green-7 are Austria, Denmark, Finland, Germany, the Netherlands, Sweden, and the United Kingdom.

4.2. GPP implementation across countries

Extensive desk research was conducted to gather evidence on GPP implementation across countries. The majority of information is from five sources: the UN fact sheets on sustainable public procurement in national governments (UNEP 2017a), the global efficiency intelligence report on the role of green public procurement (Hasanbeigi, Becqué, and Springer 2019), the 2012 EU report on the uptake of GPP in the EU-27 (EU 2012), the 2006 EU report on green public procurement in Europe (Bouwer et al. 2006), and the European Commission website, which provides country-specific information on procurement (EC n.d.-a). These sources describe the legal frameworks, GPP targets, and GPP implementation for various countries. Country-specific websites on GPP were consulted to complement these sources. A challenge was that most publications rely on self-reporting by countries. This issue was addressed by including a question on GPP implementation in the interviews to obtain insight from professionals with a deep understanding of implementation in their home country. Appendix C provides a detailed overview of the legal frameworks and targets, GPP implementation, and potential implementation gap.

In total, evidence was gathered from 55 countries on six continents. European countries are overrepresented in this analysis because their uptake of sustainable or green public procurement is longer-standing than it is in most African, Asian, and Latin American countries (UNEP 2017a). There is little evidence from African countries owing to a lack of political commitment to GPP (Akenroye, Oyegoke, and Eyo 2013); greening is not yet on the governments' agenda. In total, information on GPP is available from 3 African, 9 Asian, 10 Latin American, and 30 European countries as well as from Australia, Canada, and the United States. Table 2 describes the categories of GPP implementation.

Table 2: Categories of countries regarding GPP implementation status

Category	Description
Advanced GPP countries	Countries with a minor implementation gap: GPP policies are in place, quantitative targets are set, and uptake of corresponding actions at the national or subnational level is high
GPP gap countries	Countries with an implementation gap: GPP policies are in place, quantitative targets are set, but corresponding actions at the national or subnational level lag behind
Basic GPP countries	Countries with no or with basic GPP frameworks: there are no or few GPP policies, quantitative targets, or corresponding actions at the national or subnational level
Mixed-evidence countries	Suggestive evidence only

Almost half of the 55 jurisdictions analyzed fall under the category of GPP gap countries because there is a gap between GPP regulatory frameworks and actions or their GPP targets have not been met. Many of these countries have a high level of economic development. They have committed to greening and have corresponding policies in place. However, either they have not reached their own GPP targets or their GPP uptake is low by international comparison. In 2008 the European Commission set a target for the EU that, by 2010, 50 percent of all public tendering procedures should be green, where “green” means “compliant with endorsed common core EU GPP criteria

for 10 priority product/service groups.”¹⁶ Although the uptake of GPP in the EU has been significant, the 50 percent target has not been met (EU 2012). Some countries have made progress since 2012, but several countries still have not met this target. Considering that in 2018, 28 European countries had a GPP strategy or policy at the central level (OECD 2019a 136, the EU implementation gap is rather large.

A minority of countries (including Austria, Korea, and the Netherlands) are advanced GPP countries. These economies have GPP policies in place, and compliance with their policies is high. They have reached or almost reached their own or international GPP targets, and GPP uptake is high by comparison internationally. Austria, for example, has a small implementation gap and is in the top one-third of European countries (AU02). This does not mean, however, that these advanced GPP countries have completely greened their procurement function, nor does it mean that they have achieved all of their goals related to the greening process. Greening the procurement function does not automatically mean that the greener product has been purchased: there is still a gap between tendering for the green product and buying it (AU02; TN03). Consequently, the focus should be not only on “who implements” but also on “who buys” (RK02). Even in advanced GPP countries, some stakeholders in the procurement function are resistant to greening (TN01) or do not give greening a priority (AU01). Greening is often viewed as high-level (TN06) and as just another task on top of existing tasks (TN03). In the Netherlands, sustainable or circular criteria are often not included explicitly in mandates. Hence, advisers who are responsible for making the procurement process sustainable lack a clear mandate that they can use to change the organization internally: “Sustainability gets stuck on the ministerial level and does not reach the organizational level” (TN04).

Roughly a third of the countries have no or only basic GPP frameworks in place. Since they have not developed any, or only a few, GPP policies and have not set any GPP targets or followed international targets, there is no implementation gap in these jurisdictions. The majority of these countries have lower economic development than the implementation gap or advanced GPP countries. However, some developed countries are also in this category, for example, Greece and Luxembourg.

Finally, for a small number of countries, such as Italy and Slovakia, the evidence on GPP uptake is mixed. These countries have mandatory policies in place and have set ambitious targets for GPP, but it is not clear whether these policies are enforced in practice and whether targets are being met, making them mixed-evidence countries. This lack of evidence may be the result of the complexity of the procurement function or lack of transparency.

¹⁶ These groups of products and services are cleaning products and services, construction, electricity, catering services and food products, gardening services and products, office information technology equipment, copying and graphic paper, textiles, transport, and furniture (EU 2012).

4.3. GPP implementation across service and product groups

The potential for GPP differs between service and product groups because not all groups are equally suitable for greening. Bouwer et al. (2006) give an overview of the percentage of tenders that are green for different product and service groups in the Green-7 countries. They refer to product or service groups with more than three environmental criteria (that is, criteria that would lead to a greener product) as “solid green,” groups with one to three green criteria in their tender documents as “light green,” and groups with unclear or no criteria that would lead to a greener product as “not green” (table 3).¹⁷

Table 3: Green tenders for various product and service groups

% of tenders

Product and service group	Solid green	Light green	Not green
Sewage and refuse disposal, sanitation, and environmental services	30	52	18
Transport equipment	11	36	42
Office machinery	9	41	50
Computer and related services	—	9	92
Education, health, and recreational services	—	17	83
Professional services	3	11	86
Construction work	13	36	51
Furniture and other manufactured goods	15	30	56
Chemical products, rubber, plastic	16	28	56
Food products and beverages, restaurant services	5	38	57
Architectural, engineering, construction, installation and related technical consultancy services	9	27	64
Cleaning services	0	35	65
Medical devices	3	30	68
Paper, printed matter, printing services	19	13	69
(Electrical) machinery and communication equipment	8	21	70
Transport and communication services	11	18	71

Source: Bouwer et al. 2006.

Note: — = not available.

Some products and services are more suitable for greening than others, which explains some of the differences in greening between groups: not all product and service groups can be expected to show the same progress in greening.

How green a sector is also depends on the market power of government within that sector and how much leverage it has to steer the supply side toward becoming green (AU02; AU04; RK03; TN03; TN04; TN05). In the construction sector in the Netherlands, for example, there has been little change in supply because there has been little transition in demand (TN02), but the market reaction is difficult to measure due to the lack of reliable figures (TN05). This is a “chicken and egg” problem, because it is difficult to measure whether the supply side is providing green products

¹⁷ Such criteria include emissions of greenhouse gases or noise for buses and passenger cars, waste for packaging of cleaning materials, and water and soil contamination through the use of pesticides and fertilizers for textiles (Bouwer et al. 2006).

because the government is asking it to do so or whether the government is asking for greener products because the market is providing them (TN03). In Korea, about 800 of the 17,000 products that have obtained the Eco-label are in demand in the private market, and most of them are procurement items (RK03). Furthermore, the consumption of green products is considerably lower in the private sector than in the public sector, constituting around 13 percent of all green products purchased (RK05). Thus the pull effect in the private market is rather limited, as confirmed in the interviews (RK03).

4.4 Challenges and barriers in greening PP

This section outlines the main reasons for the implementation gaps observed in the GPP gap countries and for the reluctance to take up GPP in the basic GPP countries. Implementation challenges—difficulties in the process of greening the PP function—typically occur in the GPP gap countries, while barriers to GPP uptake are usually associated with the basic GPP countries. The distinction, though, is not always clear-cut, and some factors might be both a challenge for implementation and a barrier to GPP uptake. Despite the difficulties, understanding these issues is crucial to finding ways to address them and identifying enabling factors to support GPP reforms.

Basic GPP countries have not developed a legal framework or a national action plan. For this reason, they do not exhibit an implementation gap. Three main drivers explain their general reluctance to introduce GPP: implementation challenges, the perception that purchase prices are higher for green products, and lack of political will.

4.4.1. Implementation challenges

Modifications to the PP system are not viewed as PFM reforms; they are treated predominantly as legal matters (AU02), introduced by merely changing the provisions without accompanying measures to support implementation (RK07). Moreover, legal security in the sourcing decisions of public entities is as important as (AU01) or given more weight than economic considerations. Public procurement reforms are more complex, encompassing legal, institutional, and procedural amendments (Fritz, Verhoeven, and Avenia 2017). Greening the PP function requires taking all three of these aspects into account.

When considering the steps of administrative reform as depicted in a classical policy implementation cycle,¹⁸ the implementation phase is probably the most intricate, requiring concise planning and project management. Underestimating the amount of support that the implementers need in order to handle newly introduced systems is one of the typical failures in implementation and is reflected in a lack of practical tools and information as well as a lack of training (Bouwer et al. 2006; UNEP 2017b). Other challenges specific to GPP implementation relate to the complexity of PP, structural issues, and the supply side

¹⁸ A policy implementation cycle consists of five stages: agenda setting, policy formulation, policy adoption, policy implementation, and evaluation (Knill and Tosun 2008).

4.4.2. Complexity of public procurement

Public procurement is a multidisciplinary area, and greening is just one of many aspects to be considered in public tenders (TN03). Green criteria therefore compete with social criteria, among others (RK07). Both lack of legal and technical expertise in integrating environmental standards in the procurement process and lack of environmental criteria for products, services, and works pose a challenge for GPP implementation (AU04; TN05). Moreover, public procurers perceive the absence of effective management systems as an obstacle to ensuring the consistent application of environmental and social initiatives (Bouwer et al. 2006; UNEP 2017b; TN01; TN04). In addition, the procurement function itself as well as efforts to green the procurement function are often fragmented; many countries do not have national GPP targets, policies, or frameworks, but they may have targets at the local level (for example, Belgium, India, and South Africa). Also, in many countries, measures for implementing GPP may be different between the state and local governments or between local governments (Australia, Belgium, and South Africa).

4.4.3. The nature of administrative reforms

Any administrative reform requires a consideration of whether the systems in place can absorb the planned transformation. With a view to greening PP, a fragmented PP function, characterized by lack of cooperation between authorities and mainly decentralized procurement activity, poses a major challenge for implementation. Moreover, nontechnical factors, such as the personal belief of individuals involved in the procurement process (RK07) or the perception that green products are lower quality (RK01), determine the outcome of GPP processes to a large degree. Take the example of Korea: “Korea’s local governments have a personnel management system in which the public officials in charge of GPP frequently change. It is very common that the degree of GPP implementation of an institution varies greatly depending on the interests and capabilities of the person in charge of the GPP operation” (RK07). This variation is amplified by lack of transparency and failure to communicate the environmental and financial benefits of GPP (APEC 2013; Testa 2016; UNEP 2019b; RK01).

4.4.4. The supply side

An important factor to consider is how greening public procurement relates to the supply side. The complexity of establishing GPP in the tendering process may complicate the interaction between governments and suppliers. This complexity poses a risk to the participation of small and medium enterprises in public procurement opportunities, given their comparatively limited financial, technical, and administrative capacities (OECD 2019b; AU01).

In addition, scarcity of green options and lack of diversity hamper the effectiveness of GPP in general (RK02; RK03; RK07). In Canada the federal government is a major buyer, but its purchasing power alone is too small to enable the market to offer greener products at lower prices (UNEP 2017a). Small countries are likely to be disproportionately affected by this issue because their internal markets are small, as the example of Cyprus shows (EC n.d.-b). However, implementing GPP in accordance with markets seems crucial because dictating the terms unilaterally will fail—markets must be ready to respond to public sector demand (AU02).

From a global perspective, the absence of an international approach to GPP and the existence of tariff barriers hinder the definition of suitable trade policies to promote green public procurement. Although trade is highly internationalized, the divergence of environmental criteria for green products and the limited use of eco-labels among economies limits the options for green cross-border trade (APEC 2013). Korea has acknowledged the need for more support for international cooperation and overseas expansion and has included such support explicitly in its fourth plan on promoting the purchase of green products (Ministry of the Environment, Korea 2021).

4.4.5. The (perceived) higher purchase price

One of the largest barriers to GPP uptake is indeed the perception that green tenders are more expensive than other tenders. Even if the purchase price is not actually higher for green products, works, or services, there is often a perception that green products and services are more expensive than conventional ones (Braulio-Gonzalo and Bovea 2020; Chegut, Eichholtz, and Kok 2019; AU02; RK02; RK03). This hurdle applies to GPP gap and basic GPP countries alike, but it disproportionately affects countries with lower purchasing power, which could explain the lack of political commitment to GPP in many African countries (Akenroye, Oyegoke, and Eyo 2013).

4.4.6. Lack of political will

Lack of political support constitutes another key barrier to GPP (Bouwer et al. 2006), endangering or making impossible any reform efforts and therefore constituting a key nontechnical barrier (Fritz, Verhoeven, and Avenia 2017). Many countries report a lack of commitment to GPP (for example, the Czech Republic, Denmark, and Latvia) related to the fact that GPP policies are not binding (for example, Spain). In Korea, the lack of supporting policies leads to a gap in regulation and implementation, even though GPP is mandatory (RK01). As a consequence, even though GPP criteria are included in public tenders or overarching GPP policies exist, environmental award criteria have little influence on final decisions in supplier selection (for example, Norway). Korea has developed a comprehensive bidding system to address this issue. The system considers environmental and other factors such as quality, performance, and efficiency along with price, performance, and suitability (RK06).

In addition, monitoring mechanisms to evaluate green procurement activities and follow up on green criteria are generally absent (OECD 2015, 5). Yet clearly defined GPP targets and systematic, transparent monitoring are key to greening the public procurement function successfully and increasing the number of green products procured (Hasanbeigi, Becqué, and Springer 2019). In particular, given the absence of a common definition of green public procurement, creating GPP indicators and setting suitably high GPP targets help to establish specific implementation plans (UNEP 2017b; RK06).

Although the majority of countries have defined targets to help to green the PP function, they do not clearly define their targets or set quantitative targets that allow for consistent monitoring (China, Denmark, India, Malta, Singapore, and Switzerland), or they fail to monitor their results systematically (Australia, Austria, Norway), or their monitoring reports are vague or not publicly available (Cyprus, Italy, Malaysia). Indeed, in most countries that report having a monitoring system in place, it is not systematic (Denmark), contains inconsistencies (Israel), or is fragmented

(United States). Even countries with a high level of GPP implementation struggle with effective monitoring. Germany, for example, has a small implementation gap but is still developing a GPP monitoring process to be able to provide annual reports on GPP. Austria does not implement monitoring on a regular basis either (AU01; AU02; AU03). In Korea, in contrast, the Ministry of Environment annually publishes data on the purchasing of green products by public institutions, while KEITI monitors the purchasing performance of each institution on a quarterly basis and also analyzes and manages performance data (although reports are not publicly disclosed) (RK02).

4.4.7. Unfavorable surrounding conditions

Unfavorable surrounding conditions are a major barrier to successful implementation. Conversely, inadequate capacities could be a reason for low GPP uptake in many developing economies. The literature also highlights unfavorable aspects such as lack of automation of key functions, lack of system integration, and weak PFM institutions resulting in noncompliance and limited professional capacity (Cheng et al. 2018; Hasanbeigi, Becqu e, and Springer 2019).

5. PFM enablers

This section introduces the PFM system. However, as Allen, Hemming, and Potter (2013, 2) note, “A compact and coherent definition of PFM is surprisingly hard to find in the literature.” While the traditionalist view of PFM focuses on the technical functions of managing the public budget in its established phases, a more modern perspective has evolved in which PFM is seen “as an ‘umbrella’ definition, covering a set of systems aimed at producing information, processes, and rules that can help support fiscal policy making as well as provide instruments for its implementation” (Cangiano et al. 2014, 1–2).

In this spirit, PFM is treated here as an integrated set of (sub)systems, institutions, procedures, and processes organized around in the PFM cycle¹⁹ whose purpose is to implement fiscal policy using public resources. Public procurement is an element of budget execution and, as such, a subsystem in the PFM cycle. Building on the concepts of institutional economics,²⁰ this broad view of PFM makes it possible to examine three features of the public procurement function—form of organization, operational mode, and financial conduct—that a more conventional view would probably overlook or deem irrelevant.

5.1. Organizational structure of the PP function

How the procurement function is organized in the public sector has fundamental implications for greening public procurement. An important organizational distinction can be drawn between decentralized and centralized purchasing entities: decentralized public procurement describes a process whereby a procurement organization adopts purchasing decisions individually, while

¹⁹ Sometimes referred to as the budget cycle, which typically centers around the following elements: budget formulation, budget execution, accounting and reporting, and external audit.

²⁰ A term introduced by the economist Douglas North in 1991 (North 1991).

centralized procurement combines the procurement activities of at least two contracting authorities and can eventually culminate in demand aggregation (Albano and Sparro 2010; EC 2008; Glas, Schaupp, and Essig 2017).

Academic discussions prior to the 2008 global financial turmoil hint at a drift toward decentralized approaches and away from “the traditional model of centralized purchasing responsibility” (McCue and Pitzer 2000). However, the emergence of strategic policy goals in public procurement and increasing fiscal pressures as a result of the crisis seem to have reversed that trend. More recent studies (for example, Glas, Schaupp, and Essig 2017; Kanepejs and Kirikova 2018) observe growing efforts to centralize (at least partly) the PP function and claim that many governments all over the world “have resorted to a certain degree of centralization and charged a governmental agency with aggregating public demand and implementing centralized procurement strategies” (Albano and Sparro 2010, 2).

With a view to greening the procurement function, this section analyses whether and how centralized procurement structures and joint procurement arrangements could be an effective instrument in achieving secondary policy goals through government spending, such as mainstreaming environmental considerations into the procurement process (Albano and Sparro 2010; Glas, Schaupp, and Essig 2017; OECD 2000).

5.1.1. Development of the hypothesis

The current academic debate seems to favor centralized procurement systems: “Centralization can play a key role in promoting green procurement policies and establishing appropriate common standards (Dimitri, Dini, and Piga 2006, 64). Not only are joint procurement structures seen as the means of choice for targeting broader policy objectives (Albano and Sparro 2010; OECD 2000), but decentralized PP is also perceived as not suitable (Glas, Schaupp, and Essig 2017). Dimitri, Dini, and Piga (2006) argue that decentralized units may perform better in day-to-day purchasing, while centralized ones are superior in strategic purchasing.

An empirical study by Glas, Schaupp, and Essig (2017) demonstrates that centrally organized PP systems are more effective in implementing green objectives than decentralized ones: centralized arrangements deliver strategic goals, whereas decentralized forms of procurement carry out the procurement function itself, even in an environment where GPP is embedded in regulation. That study has several shortcomings, which it addresses: first, the paper has a narrow regional scope, focusing on Germany only. Second, only secondary data are analyzed, stemming from a survey that was conducted for a different purpose. And last, but not least, the hypothesis is slightly different, as it tests whether centralized PP organizations exhibit a better strategic fit.

Testa et al. (2016) and Test (2016) emphasize the relevance of the size of a public organization in determining its ability to include sustainability criteria in its public tenders due to lack of appropriate skill. Moreover, Michelsen and de Boer (2009) find “a positive and statistically significant correlation between the size of a public organization and its GPP performance” (Testa et al. 2016, 199). Although organizational structure is not the research focus of these papers, they offer lessons regarding the issue of centralization: in smaller units with a leaner organization, the procurement function is likely neither very mature nor carried out by professional procurers. In

such cases, organizing purchasing activities at an aggregate level will improve the capacity to implement GPP as a result of better access to appropriate human resources and skills.

This study therefore examines the hypothesis (H3a): centralizing the PP function facilitates the implementation of GPP. This research question has not been examined to date, and there seems to be no empirical proof for a hypothesis that is presented throughout the GPP literature as fact.

5.1.2. Organizational structure and delivery of strategic objectives

Empirical evidence suggests that organizational architecture plays a major role in the implementation of strategic, horizontal objectives, such as those of a socioeconomic or environmental nature (Glas, Schaupp, and Essig 2007). The literature implies that the degree of centralization of a procurement system is linked to the implementation of strategic goals: centralized and decentralized arrangements differ in their ability to promote horizontal aspects, such as GPP (Albano and Sparro 2010; Glas Schaupp, and Essig 2007; Handler 2015; OECD 2000).

Table 4: Key arguments in support of centralized procurement systems

Argument	Details
Economies of scale	<ul style="list-style-type: none"> • Lower purchase prices of goods, services, and works through bulk purchase • Increased purchasing and bargaining power • Lower administrative overhead, such as sharing of costs for complex information technology and lower staff costs, as a result of bundling of services • Avoidance of duplication of transaction cost for homogeneous contracts
Improved (social) value for money	<ul style="list-style-type: none"> • Highest possible quality-price ratio for better services, goods, and works at lower cost • Acquisition of social value through internalization of positive external effects
Higher integrity of the purchasing system	<ul style="list-style-type: none"> • Better transparency provisions through financial reporting and effective management controls and clearer audit trails • Avoidance of local favoritism and corruption
Optimization of the procurement process	<ul style="list-style-type: none"> • Increased specialization in the provision of specific goods and services, like medical or military equipment • Enhanced professionalization and easier management of staff performance • Improved contract management and monitoring of supplier's performance • Effective provision of standardized products and technical equipment, such as information technology systems and software • Knowledge and information sharing to find common solutions to common problems

Sources: Albano and Sparro 2010; Dimitri, Dini, and Piga 2006; Glas, Schaupp, and Essig 2017; McCue and Pitzer 2000; OECD 2000.

From the perspective of the primary objectives of PP,²¹ however, there are various arguments in favor of each of the two main organizational types. Tables 4 and 5 present key arguments in support of centralized or decentralized procurement, respectively. Each form has particular strengths and weaknesses, which are discussed in the next section. Two questions are examined in this context: (1) Which organizational architecture is helpful or is necessary with a view to greening PP and addressing the challenges of implementing GPP? and (2) Does a certain degree of centralization ensure consistency with the primary objectives of the procurement function, while preserving the major benefits of either form of organization?

Table 5: Key arguments in support of decentralized procurement systems

Argument	Details
Safeguarding of business competition	<ul style="list-style-type: none"> • Greater possibilities for small and medium enterprises to compete in the bidding process because large-scale contracts may exclude smaller, local suppliers • Demand aggregation, leading to increased market shares and possibly to lock-in situations with overspecialized suppliers
Increased flexibility in service provision	<ul style="list-style-type: none"> • Improved ability of service delivery managers to adapt more quickly to changing conditions and the needs of service users, for example, in case of emergency • Improved effectiveness in dealing with demand heterogeneity regarding differing needs or preferences for delivery conditions and payment modalities • Increased responsiveness to unexpected events such as overconsumption or inadequate quality
Leaner procurement administration	<ul style="list-style-type: none"> • Less bureaucracy because of shorter time frames, fewer forms for both purchasers and suppliers, as well as fewer reporting lines • More scope for employees to take individual responsibility and develop a “service” mentality • Less scope for mistakes affecting large-volume purchases that result in unnecessary overspending
Closer to the market	<ul style="list-style-type: none"> • Closer matching of goods, services, and works tailored to the requirements of end users • Quicker reactions to specific market dynamics, such as innovative opportunities coming from decentralized markets

Sources: Albano and Sparro 2010; Dimitri, Dini, and Piga 2006; Glas, Schaupp, and Essig 2017; McCue and Pitzer 2000; OECD 2000.

²¹ Referring to the delivery of goods and services in a timely, economical, and efficient manner (OECD n.d.-a).

5.1.3. Relevance of centralization for greening PP

There are three key arguments in favor of centralization when envisaging the implementation of green public procurement (Albano and Sparro 2010; OECD 2019b, 2000): (1) amplified purchasing power through bulk purchases and large-scale contracts, (2) creation of social value through internalization of positive external effects, and (3) increased specialization and deepened professionalization as a result of pooling human resources.

5.1.3.1. Increased purchasing power and market structure

One of the advantages of centralized systems is the increased purchasing power achieved through bulk purchases and large-scale contracts, as “ ‘how’ the process is carried out not only determines the efficiency and effectiveness of public spending but can also influence the behavior of the private sector” (OECD 2019b, 12). A market “pull-effect” is exerted, creating a trend that gives important signals to private market suppliers to meet the higher demand for environmentally friendly products, services, and works. An assured market of relevant size and sales potential will spur entrepreneurial spirits and motivate firms to offer new products and processes that meet green criteria (Albano and Sparro 2010).

According to the theory of equilibrium, as the supply of sustainable solutions accelerates, their prices will decline, and they will become more affordable for end consumers, further boosting demand. Moreover, governments act as role models for private demand and citizens by demonstrating their commitment to reducing CO₂ emissions: “The public sector is in a position to set forward (or even switch) the dominant standard for commonly used products and processes” (Albano and Sparro 2010, 9f). The potential impact of governments buying green is therefore threefold: (1) the initial effect of elevated public demand, (2) the supply-side spillover effect, and (3) the increase in demand from private consumers.

5.1.3.2. Social value and internalization of positive external effects

In general, eco-friendly solutions exhibit a more favorable carbon footprint than their non-green substitutes. They consume fewer nonrenewable resources, conserve the ecosystem, and prevent unnecessary waste and pollution throughout their life cycle. Green products, services, and works thus create social value by generating positive or reducing negative externalities. Aggregating demand assists in internalizing these environmental benefits, which can accrue to the whole society (Albano and Sparro 2010).

Moreover, smaller purchasing entities in a decentralized environment often underestimate the positive effect of buying green, and direct interests may be too close to keep at “arm’s length” (RK07). This underestimation can be counterbalanced by centralized procurement strategies: “The positive effects (externalities) produced by purchasing environmentally sustainable items through local units can be magnified by large-scale centralized procurement. Since a small local procurement unit may not give sufficient importance to the environmental impact of its tendering competitions, the more procurements are centralized, the more this negative externality is reduced” (Dimitri, Dini, and Piga 2006, 64).

5.1.3.3. Increased specialization and enhanced professionalization

Public sector procurement is already a very technical and interdisciplinary field, requiring a broad set of competencies, such as specific market knowledge, business and negotiating skills, legal expertise, and know-how in the area of costing and pricing. Greening the procurement function adds complexity, as additional skills and knowledge are necessary in developing GPP practices, drafting green guidelines, designing technical specification, determining award criteria, and calculating the real cost of a purchase throughout its life cycle.

Appropriate environmental capacity must be built by training existing staff or hiring suitable human resources. In a highly fragmented environment characterized by a decentralized PP function, additional costs are imposed on single purchasing units. By pooling specialized resources and sharing knowledge, which are perceived as some of the key positive externalities of joint arrangements, these costs can be significantly reduced and economized. Moreover, centralized procurement is seen to bring increased professionalism by employing specialist procurers, which will further enhance economic benefits (Albano and Sparro 2010; OECD 2000).

5.2. Electronic public procurement

The term “e-procurement” refers not only to automation of the procurement process: according to the OECD (2015, 140), e-procurement describes “the integration of digital technologies in the replacement or redesign of paper-based procedures throughout the procurement process,” hinting at its transformational capacity to reengineer the PP process as a whole or to modernize individual stages of procurement. Although there is no one-size-fits-all solution in terms of functionality, basic system architecture has two high-level components: the procurement portal and the procurement management information system (PMIS) (ADB 2013).

A web-based PP portal serves as an interface between buyers and suppliers—either government-to-business or government-to-government. It operationalizes the actual purchasing and provides transactional as well as informational services to its users, including the general public. A PMIS provides an umbrella function in soliciting, organizing, and analyzing information relevant for managing the procurement function. While the “web portal is essentially the shop front and postbox for government procurement,” the PMIS addresses critical PP management activities, like monitoring and reporting (ADB 2013, 85). Both elements should be linked and ideally interface with an integrated financial management information system (IFMIS) (AU02); however, they can also be implemented and operated as stand-alone instruments (ADB 2013; EBRD 2015). Table 6 provides more detailed information on the options for a specific functionality.

Table 6: Basic model for e-procurement architecture and exemplified functionalities

System	Purpose	Steps and tasks
Procurement management information system	Procurement management	<ul style="list-style-type: none"> • Procurement planning and alignment with financial planning and budgeting: transaction and supplier analysis • E-contract management: performance assessment; contract settlements, variations, and cancelations • E-records: tracking, reporting, and auditing of procurement activities • Workflow management: integration and interfacing with the integrated financial management information system (IFMIS) and inventory management tools
Web-based procurement protocol	Actual purchasing	<ul style="list-style-type: none"> • E-information and e-notification: supplier and buyer registries; notification on procurement opportunities; list of current bids; and laws and regulations • E-tendering and e-bidding: procurement of specialized works, goods, and services of high value and low volume; document and bid uploads; bid matching and tracking; and award decisions • E-purchasing: procurement of standard works, goods, and services of low value and high volume; supplier-managed catalogs (e-catalogs); and option for direct quotation (e-marketplace) • E-payment and e-invoicing: management of all payments made and received in the procurement process

Sources: ADB 2013; EBRD 2015.

5.2.1. Development of the hypothesis

The available literature widely acknowledges that e-government solutions, such as electronic procurement, play an important role in mainstreaming environmental considerations into the PP process (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019; Glas, Schaupp, and Essig 2017; Walker and Brammer 2012); however, only one study was found that analyzes their link empirically. Walker and Brammer (2012) focus on the relationships between sustainable procurement, supplier communication, and e-procurement, examining whether the adoption of e-procurement practices helps to operationalize GPP. For this purpose, they surveyed public procurement professionals in 20 countries, finding a strong, positive, statistically significant relationship between the use of information technology in procurement activities and environmental, labor, health, and safety aspects of sustainable procurement. E-procurement, however, is a rather broad term, and their paper does not provide information on which aspects of the procurement cycle automation facilitate GPP the most.

E-procurement and how it relates to sustainable PP is an underexplored subject and needs to be studied further. To contribute to closing this gap, how the automation of the PP function or stages

of the procurement cycle contribute to GPP implementation is explored next. In contrast to Walker and Brammer (2012), focus is placed on the environmental aspect and the relevance of specific functionality in e-procurement systems, examining hypothesis (H3b): e-procurement is essential in enabling and facilitating GPP implementation.

5.2.2. The public sector has entered the digital era

Nowadays, public sector acquisitions of information and communication technology account for approximately half of new capital investment globally. Such acquisitions are profoundly affecting and transforming how governments interact with their constituents. Developing countries also have “consistently advanced their e-government structures” (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019, 189). Regarding the application of e-procurement, however, only a few countries, such as Korea and Singapore, have successfully implemented straight-through and end-to-end electronic PP solutions. In most jurisdictions, one or more stages and functionalities related to the beginning of the PP cycle (the preparatory and tendering phases) are automated, such as e-publication, e-tendering, and e-catalogs (ADB 2013; OECD 2015).

As conventional public contracting is “recognized as bureaucratic and rigid, requiring frequent renegotiation and proactive conflict management,” its digitalization contributes to the evolution of an efficient, transparent, and less bureaucratic society, with “positive impacts on buyer-supplier relationships” (Costa, Arantes, and Tavares 2013, 238f). Governments report that using electronic tools in public procurement offers a range of important benefits (ADB 2013; EBRD 2015; OECD 2016; RK07):

- Increased efficiency through standardization of documents, streamlining and integration of processes, and quicker decision-making
- Enhanced transparency and accountability induced by the availability of comprehensive PP information by suppliers, the general public, and government agencies, clear and uniform allocation of roles and responsibilities, and improved tools to address fraud and corruption
- Savings on procurement from increased bidder participation, lower bid prices as a result of better and open competition, shorter processing time, and less red tape
- Balanced economic development through improved accessibility to PP information and new business opportunities.

5.2.3. Relevance of e-procurement for greening PP

Greening PP, however, is a sophisticated undertaking. Governments may leverage the use of e-procurement tools with a view to developing new metrics for enforcement and assessing the impacts of GPP, which will help to reduce complexity and control the cost of implementation (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019). Automation also reduces the amount of paper and transport involved in tendering and hence contributes to a greening of the purchasing

and supply process by default (EC and ICLEI 2016). As such, e-procurement is highly relevant in mainstreaming and operationalizing the greening of the PP function.

E-procurement systems add particular value by providing information and ratings on green products, works, services, and suppliers in e-catalogs and facilitating the search for eco-friendly items. They simplify defining and including mandatory eco-friendly clauses in public tenders and contracts by using a contract management solution, monitoring (country-specific) GPP indicators, and verifying compliance with green requirements. Automation can also support the calculation of life cycle cost based on information provided by suppliers. Moreover, electronic procurement is an option for harvesting the benefits of decentralization while operating in centralized systems (Glas, Schaupp, and Essig 2017). It allows purchasers to be close to the market, while compensating for lack in professional procurement capacity and thus combining the benefits of both centrally organized and decentralized PP structures (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019; Clement, Watt, and Semple 2016; EC and ICLEI 2016; Walker and Brammer 2012).

5.3. The role of life cycle costing in PP

Life cycle costing is a broad term that refers to combining cost accounting and conventional methods of calculating investment costs with the goal of implementing more sustainable business practices. From a user and procurement perspective, it is a “methodology to evaluate all of the costs over the life cycle of works, supplies, or services” (SIGMA Programme 2016, 2). It encompasses costs related to acquisition, use, consumption of resources, maintenance, and end of life. The cost of externalities, such as greenhouse gas emissions, can be added, provided that their monetary value can be determined and verified (EC and ICLEI 2016; Hunkeler and Rebitzer 2003; Öko-Institut e.V. 2007); however, this is not requirement, and, as such, LCC differs from LCA and CF calculations.

5.3.1. Development of hypothesis

The link between GPP and LCC has been analyzed before (de Giacomo et al. 2019; Iraldo, Nucci, and de Giacomo 2016), although those papers differ from this study in that they examine whether experience in GPP stimulates adoption of the life cycle approach in public procurement. Their underlying hypotheses therefore assume a reverse dynamic and differing effect. Broadly speaking, both studies find the causal links between the two concepts to be weak and emphasize the barriers to LCC implementation, such as poor data availability, inadequate access to training and tools, and methodological issues. The results should be interpreted with caution, though, as it is unclear which definition of LCC they use to examine the links between GPP and LCC.²²

However, the literature widely recognizes the relevance of LCC in greening the public procurement function or at least considers a wider concept of costing beyond purchase price. Some

²² Bearing in mind the various approaches to LCC, it is possible that respondents to the questionnaires use a different definition of LCC than the researchers, which can lead to distortions in the data set. Indeed, this distortion is problematic throughout the literature, as it challenges the comparability of research results.

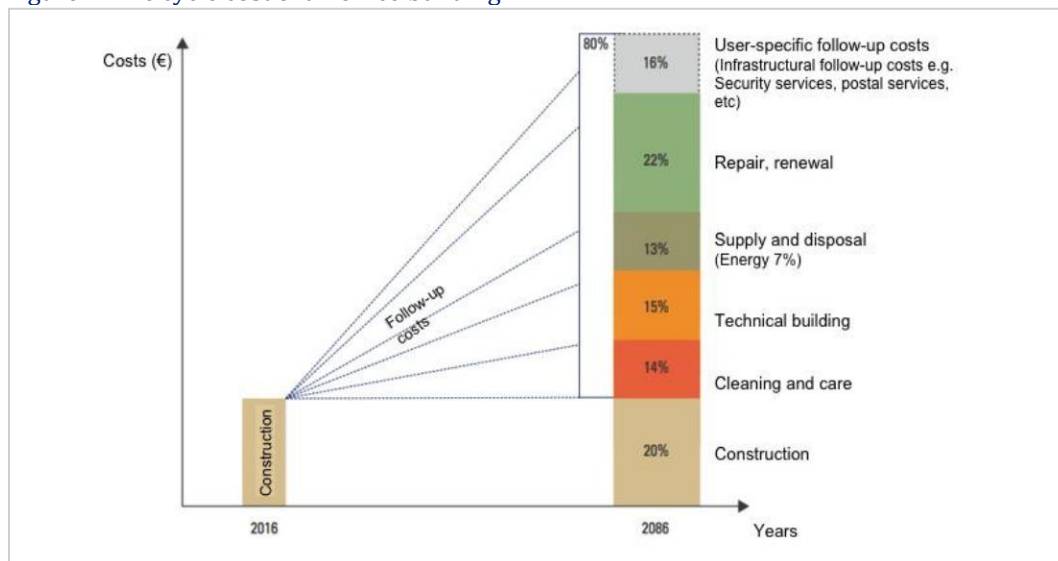
studies have found a positive statistical correlation between the inclusion of a life cycle perspective in public tendering and the greenness of a tender (de Giacomo et al. 2019; Iraldo, Nucci, and de Giacomo 2016; Morton and Perfrement 2009; Öko-Institut e.V. 2007; Testa 2016). This section examines hypothesis H3c: the application of LCC and the integration of LCC in the procurement process will foster the uptake and implementation of GPP.

5.3.2. LCC methodology and practice in public procurement

There is no uniform terminology for LCC, and various terms are used interchangeably, such as total cost of ownership, whole life costing, and whole life value. Initially, the life cycle engineering approach was deployed in the production phase of goods to increase their quality while reducing costs, as the design of a product can be a major driver of cost. In the public sector, LCC was first deployed by the US Department of Defense in the purchase of military equipment. The use of this tool was “stimulated by findings that operation and support costs for typical weapon systems accounted for as much as 75 percent of the total cost” (Asiedu and Gu 1998).

Buildings provide a good example of follow-up costs over the life cycle of an investment. Figure 1 demonstrates the distribution of life cycle costs of an office building during the 70 years after its construction, showing that initial investment costs account for just 20 percent of total costs. A study that calculates and compares life cycle costs for 11 product groups consisting of 27 product types finds, “In most cases the operating costs have a significant share of the purchasing authorities’ total costs” (Öko-Institut e.V. 2007, 2). It recommends taking them into account in purchasing decisions.

Figure 1: Life cycle cost of an office building



Source: Estevan and Schaefer 2017, 29.

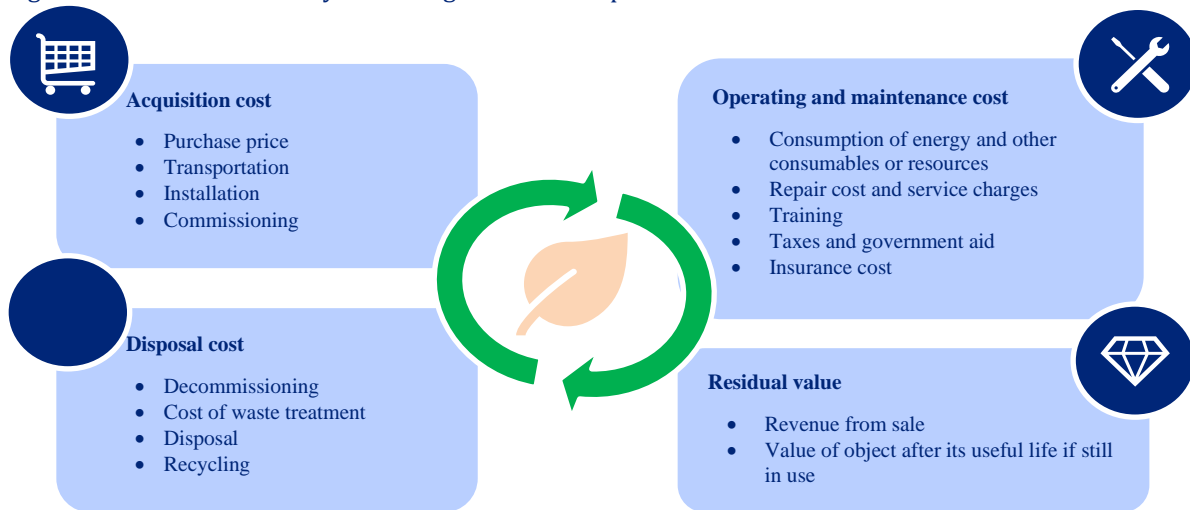
Costing systems and costing practices are constantly evolving and are determined to a large degree by what the organization aims to achieve (Mohr 2019). Hence, the LCC practice is far from uniform and standardized, and procurers around the globe have adopted a variety of approaches,

formats, and methods (Morton and Perfrement 2009). The various approaches to LCC assessments differ in their degree of comprehensiveness regarding the costs taken into account. The “conventional” LCC methodology—the most common one—deals with traditional financial assessment and includes, broadly, four types of costs (figure 2). The conventional approach, instead of trying to monetize external costs, views government taxes as they relate to environmental aspects or resource use as some form of internalized externality. To this extent, it resembles the classic TCO concept often used in the private sector.²³

The LCC methodology implies considering a certain time horizon; as such, it contains an element of market forecast to estimate the future prices for operating media (such as electricity, fuel, and gas). A discount rate can be included in the calculation, as present and future costs have to be evaluated differently. For each product or service, the relevant cost elements are considered, whereas their “relevance” is determined either by their share in the overall costs of the item purchased or by whether they are specific to their green or non-green, properties. Not least, the methodology requires the allocation of related indirect or overhead costs (Estevan and Schaefer 2017; Iraldo, Nucci, and de Giacomo 2016; Öko-Institut e.V. 2007).

LCC analysis is applicable not only in the awarding phase of PP but also in various stages of the PP process, as presented in figure 3.

Figure 2: Conventional life cycle costing model in the public sector

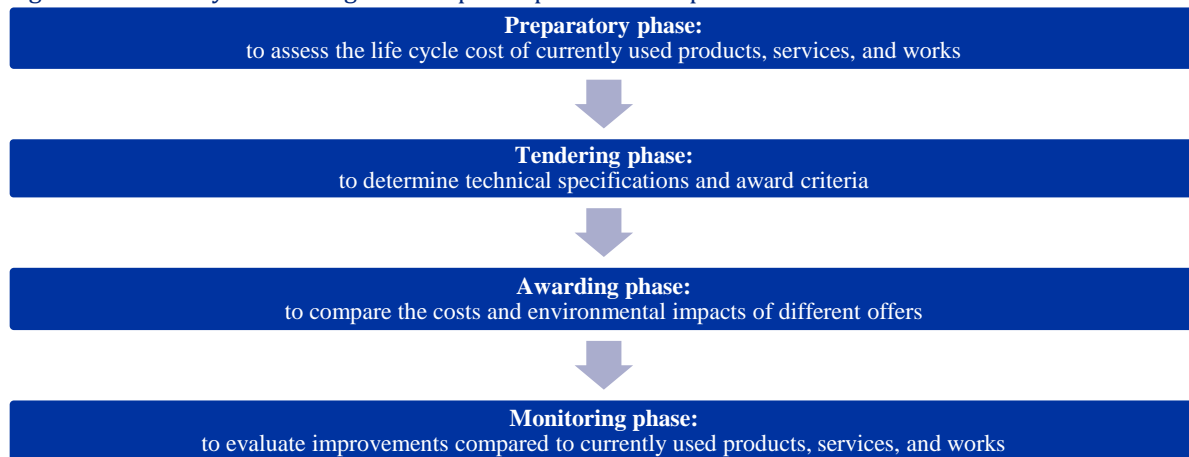


Sources: Estevan and Schaefer 2017; SIGMA Programme 2016; Testa et al. 2016.

Despite the numerous advantages for organizations, the application of LCC today is still very limited, particularly in the public sector, and not common practice in GPP (de Giacomo et al. 2019; Estevan and Schaefer 2017; Testa 2016). According to a 2013 UNEP report, the majority of respondents said that they use LCC “sometimes for some product categories” or “rarely,” 17 percent don’t use it at all, while only 2 percent use it in all procurement cases (UNEP 2014).

²³ TCO is used to calculate the total cost of purchasing and operating a technology product or service over its useful life.

Figure 3: LCC analysis and stages of the public procurement process



Source: Estevan and Schaefer 2017.

5.3.3. Relevance of LCC for greening PP

Green procurement is concerned with the longer-term consequences of each purchase, focusing on the environmental effects of products and services throughout their life span. Life cycle costing is the appropriate instrument for integrating economic and sustainability considerations in public procurement. Presumably, a price premium must be paid for the greener option, but it is often “offset through efficiency gains, cost savings, and lowered risks during the product/project lifetime” (Morton and Perfrement 2009, 1).

Financial and nonfinancial gains offered by green substitutes often accrue over the whole life cycle; hence, the purchase price is not an optimal indicator of value-for-money. LCC helps to direct public funds toward goods, services, and works that reduce the consumption of energy, consumables, and natural resources, prevent waste, and improve livelihoods. Oftentimes, the use phase is very cost-intensive; hence LCC has the capacity to detect the economically most advantageous bid and demonstrate real value-for-money, while at the same time identifying the most environmentally sustainable solution (Hunkeler and Rebitzer 2003; Morton and Perfrement 2009).

6. Findings and recommendations

Although green public procurement has received increasing attention over the past decade, stimulating an academic debate on the potential of public procurement to address climate change, few research papers cover this topic. This study has investigated how the PFM system can help to establish green considerations in public procurement so that government spending can contribute to a reduction in CO₂ emissions. It has sought to shed light on how exactly the PFM system and climate change considerations are interrelated via public procurement and what this interrelation means for greening the PP function. The existence of structural obstacles indicates the need for technical interventions to optimize the PFM environment in order to absorb greening reforms in

public procurement better and more effectively. The focus is on identifying enablers for greening PP by looking through the PFM lens.

A purely functional approach was adopted to draw specific recommendations. Rather than categorizing countries according to their level of economic development, the proposed menu of options considers the functional maturity of aspects of their PFM system, while taking into account capacity issues. PFM systems differ widely in their characteristics and performance among countries at the same level of economic development. Moreover, the level of economic development of a specific country does not necessarily correlate with the performance of its PFM system. This broader systemic and functional approach is novel in the literature.

The research addressed three research questions:

1. Can public procurement contribute to a reduction of CO₂ emissions?
2. Is there is an implementation gap between the GPP regulatory framework and GPP practice?
3. How can the PFM system contribute toward closing the implementation gap and greening PP?

6.1. Governments can have an impact on CO₂ emissions through GPP

Although the size of the effects of GPP measures on CO₂ emissions is difficult to interpret, taken together, these numbers provide evidence that GPP does have an effect on CO₂ emissions. The experts interviewed all agreed with this finding. The potential for GPP to reduce emissions results from the sheer volume of public sector purchases, among others (RK03). The public sector is predisposed to lead the way in greening because it is in a position to take risks in the form of paying a higher purchase price or using innovative technology (TN03). Also, governments can combine green targets with other targets to reap the benefits of mutual reinforcement. For example, social targets that create a social impact may have a further impact on emissions. At the same time, governments must consider other potential outcomes associated with greening, which implies maintaining flexibility with regard to the impacts or outcomes of green measures (TN05). For example, if government is considering shifting to solar energy to curb emissions, it should also consider the additional waste that this shift may create (TN05). Not least, governments can lead the market (a) by displaying a willingness to procure green products if they provide subsidies or grants to suppliers who are willing to go green (TN03) or accept a higher purchase price in favor or choosing a green product (TN03) (which in many cases will still have a lower cost over its life cycle than a non-green product) or (b) by holding companies accountable not only for how they spend their money, but also for their emissions (CO₂ budgeting).

The sectoral analysis illustrates which economic sectors or product groups are more suited for greening—that is, it identifies “hot spots” for greening. For example, the potential for greening differs widely for different modes of transport, while this discrepancy seems to be much smaller

for different types of lighting. Thus, if governments want to reap the potential of GPP to reduce emissions, they should focus on those sectors where the impact of GPP is expected to be highest (TN05). They should consider how easy it is to green the sector as well as the size of the sector and how much market power the government has in it.

The potential of GPP to reduce CO₂ emissions has not been fully realized (TN05), and governments have to continue closing the implementation gap.

6.2. In the majority of countries, there is an implementation gap

The research has found that countries are at varying levels of GPP implementation, ranging from no implementation at all to an advanced stage of implementation. However, even advanced GPP countries have not completely greened their procurement function, and having implemented green criteria does not mean that the greener products are being bought effectively. Thus, careful consideration has to be given not only to “who implements,” but also to “who buys” (RK02). Moreover, resistance to greening is evident even in advanced GPP countries. It is therefore important to implement GPP as inclusively as possible (TN02) and to ensure that GPP does not “get stuck on a ministerial level” (TN04). Given the absence of a clear definition of GPP, having measurable GPP indicators for monitoring the uptake of green criteria plays a vital role in this regard.

With a view to greening the public procurement function, the existing PFM environment is crucial, as certain systemic preconditions have to be met in order to mainstream eco-friendly considerations successfully into PP.

6.3. The PFM system can contribute toward closing the implementation gap and greening PP

Several challenges to implementing GPP across countries and service or product groups can be addressed from the PFM perspective. The PFM system offers solutions and tools for surmounting these obstacles in the form of organizational, operational, and financial conduct: in addition to the organizational form of PP (hypothesis H3a), e-procurement (hypothesis H3b) and LCC (hypothesis H3c) can play important roles in closing the implementation gap and greening the PP system.

The remainder of this subsection outlines concrete recommendations for how to modify PFM enablers to support GPP implementation.

6.3.1. The organizational structure of the PP function is crucial with regard to greening

The academic discourse focuses on the two main structural archetypes of PP: centralized or decentralized. Conceptualizing PP in this way can be misleading, as it does not differentiate between legal and organizational aspects. Furthermore, many countries pursue a nuanced approach by mixing elements of centralization and decentralization in organizing their procurement operations: the Netherlands, for example, has a legally decentralized PP environment but exhibits frequent institutionalized collaboration in its PP operations (TN03). Austria, by contrast, has established a central purchasing body at the federal level, but only for buying consumer goods, and separate purchasing decisions of individual entities are possible, but discouraged (AU02). Finally, Korea operates both centralized and decentralized systems to ensure a certain level of autonomy for individual local governments and public institutions (RK04). In practice, there is no fully articulated centralized or decentralized public procurement function; rather, systems show a “degree of centralization” (Glas, Schaupp, and Essig 2017), which is the preferred terminology in this context.

The degree of centralization ranges from low, taking the form of ad hoc arrangements of a collaborative nature, to high, ushering in the establishment of (centralized) permanent purchasing bodies. Various types of organizational procurement practice can be found across all levels of government: “central purchasing agency, national purchasing groups, regional procurement groups, situation-specific local buying consortia, central framework contracts for decentral[ized] use, international buying centers, specialized agencies for categories (e.g., medicine or defense), shared service centers, outsourced purchasing offices to private sector, purchasing offices in the form of public-private partnerships, and ... many other organizational practices and supportive instruments, such as e-procurement platforms” (Glas, Schaupp, and Essig 2017, 576).

During the field research, participants differentiated between legal and organizational centralization. There is evidence that, in general, some degree of centralization is necessary to mainstream environmental considerations into the PP function and institutionalize GPP. This evidence supports hypothesis H3a: centralizing the PP function facilitates the implementation of GPP. In Austria as well as in the Netherlands, institutionalized cooperation is a vital ingredient of implementing GPP: the Austrian PP landscape is highly centralized, with a central purchasing body and specialized buying centers at the federal level as well as regional purchasing bodies in five of nine regions that aggregate demand from their municipalities. The Netherlands, although decentralized from a legal perspective, uses procurement collaborations at the municipal level to negotiate joint green criteria for purchase projects and one-stop-shop centers to support the demand as well as the supply side of GPP. In Korea, the public sector is uniformly represented via an e-procurement portal, facilitating GPP. Furthermore, participants highlighted the efficiency gains for GPP resulting from centralized structures (AU01; AU02; AU03; AU04; RK01; RK02; RK03; RK04; RK07; TN02; TN03).

Regarding the advantages of having a higher degree of centralization, participants focused on three main aspects:

1. Strategic public procurement,²⁴ such as GPP, requires all institutions affected to adopt a structured and coordinated approach. The more stakeholders are involved, as is the case in decentralized, fragmented PP environments with a low degree of institutionalized cooperation, the higher is the reconciliatory effort that has to be made and the more the implementation process becomes essentially unmanageable (AU01; AU02; AU03; RK07; RK02). This is especially the case if there is a low level of understanding or awareness of GPP (RK01).
2. Pooled knowledge and a higher degree of professionalization are uncontested positive factors of more centralized PP structures, especially with a view to the specific knowledge required for GPP (AU03; AU02; RK01).
3. In principle, increased market power as a consequence of demand aggregation contributes to successful GPP implementation. However, aggregating demand with the aim of incentivizing sustainable production is only relevant in branches where the public sector already has a high market share (AU02; TN03; TN04).

Although there is evidence for hypothesis H3a, this does not necessarily mean that (legal) centralization of public procurement per se should be promoted altogether, unless, in addition to considering GPP implementation, centralization can tackle other challenges within the PP system.²⁵ From the perspective of the primary objectives of public procurement,²⁶ there are good reasons for choosing either organizational structure (as described on tables 4 and 5). Although “full” centralization for the sake of greening PP seems neither sensible nor necessary (TN05), switching to a higher degree of centralization should be envisaged as supporting GPP implementation. However, it is difficult, if not impossible, to define the “right” degree of centralization, as this depends on the country context and status quo: following the advice of Albano and Sparro (2010), employing a flexible approach by choosing from a menu of options seems a pragmatic way forward.

The field research also identified another structural issue: fragmentation of the PP function (TN05). While the responsibility for public procurement law typically lies within one ministry (the Ministry of Justice in Austria and the Ministry of Economic and Climate Policy in the Netherlands), PP policies concerning innovation, social, or environmental sustainability and implementation responsibilities are often scattered across several ministries, departments, and agencies. Moreover, PP is hardly perceived as part of the PFM process, reflected in the fact that the central financing agencies, such as the ministry of finance or treasury, only play a minor role in the process. Consequently, clear and sufficiently mandated reform drivers are missing at the administrative level, a role often performed by central financing agencies. Hence, proper implementation of GPP is lacking, and injecting tools “without making other changes may not to be effective” (Fritz, Verhoeven, and Avenia 2017, 39).

²⁴ Strategic public procurement “refers to the broadest concept of PP which, in the context of the ‘Europe 2020’ Strategy, comprises not only economic, social, and environmental goals, but also innovation and a number of other possible objectives of public policy, such as education and public health” (Handler 2015).

²⁵ Such as corruption, lack of professional capacity, and other inefficiencies leading to wasteful handling of public funds.

²⁶ Referring to the delivery of goods and services in a timely, economical, and efficient manner (OECD n.d.-a).

The following recommendations are intended to address these issues.

1. Buyer groups—a collaborative ad hoc arrangement of several buying entities—are the minimum option in terms of strategic cooperation to buy green. In 2020 in the Netherlands, which has a legally decentralized PP environment, more than 200 public sector entities were organized in 16 buyer groups to coordinate on joint green purchasing criteria, and there were 51 procurement collaborations at the municipal level, some of which resemble a shared service center, while others do joint procurement and hence aggregate demand on a structural basis (TN03). In the case of buyer groups, the market is confronted in a unified way, which helps bidders to identify common preferences of the public sector and to adjust their supply accordingly and sustainably. This minimum option should be complemented by specialized supporting agencies, organized as one-stop shops, offering advice to both the demand and the supply sides and providing technical support related to GPP aspects. This approach has proven successful in the Netherlands, where buyer groups are not formed at the initiative of the municipalities, but their establishment is coordinated and funded by such a supporting agency (TN02; TN03; TN04).
2. Aggregating demand across several public sector entities to conduct joint purchases is another possibility. In the case of homogeneous contracts for similar products and services, demand aggregation can lead to economies of scale by lowering transaction costs (Albano and Sparro 2010), especially when the green substitutes of those products and services have significantly lower life cycle costs and lighter carbon footprints (for example, energy and information technology hardware). This approach can be organized as noninstitutionalized arrangements, as in the Netherlands, where at federal level, one ministry is responsible for the procurement of all other ministries in certain categories (TN03).
3. Central purchasing bodies fall under the category of institutionalized joint procurement and are generally seen as very effective in implementing GPP. However, demand aggregation should be considered at the lowest possible level of government—for example, purchasing bodies at the federal level should administer the procurement of central government entities, and purchasing bodies at the regional level should oversee the purchases of municipalities. In the interviews, experts frequently mentioned the combined benefits of centralized procurement and markets as well as proximity to buyer needs (AU02; AU04; RK03; TN06).
4. GPP implementation works best in PP environments that exhibit a higher degree of centralization. However, electronic procurement can also harvest the benefits of decentralization while operating in centralized systems (Glas, Schaupp, and Essig 2017; RK01). When state-of-the-art e-procurement systems are employed, how the procurement function is organized becomes of secondary importance: these systems simplify the search for eco-friendly suppliers, defining and including mandatory eco-friendly clauses in public tenders and contracts by using a contract management solution, monitoring the use of green criteria, and verifying compliance with green requirements. In this manner, modern e-procurement allows purchasers to be close to the market while also compensating for lack

of professional procurement capacity; it thus combines the major benefits of both organizational structures.

5. Irrespective of the degree of centralization and the chosen option to cooperate strategically, the institutional setup of public procurement should be addressed. Complex and fragmented environments can affect the potential for pursuing PFM reforms (such as GPP implementation) and may “entail gaps, blockages, or friction if the roles of various ministries, departments, and agencies are not sufficiently well defined or are partially overlapping or competing” (Fritz, Verhoeven, and Avenia 2017, 40). Public procurement is part of the PFM function and should be viewed as such; it is not just a legal or a business matter. Consequently, it should be integrated organizationally under the roof of the central financing agency, such as the ministry of finance or treasury, in order to be managed holistically. Alternatively, but equally effectively, the central financing agency could be mandated to conduct PP control and monitoring (including GPP activities), ideally across all levels of government, to solicit data and improve comprehensibility, because only what is known and visible becomes manageable. Similar efforts have been undertaken in Austria based on recommendations of the country’s supreme audit institution, where to date there have been only estimates as to how much the public sector, including all levels of government, spends on procurement activities (AU02; AU03).

6.3.2. E-procurement can facilitate greening the PP function

The OECD, in its Recommendation of the Council on Public Procurement, stipulates that employing recent information and communication technology to integrate e-procurement solutions will contribute to improving primary PP objectives, such as the timely, effective, and efficient delivery of public services to citizens in an economical manner (OECD n.d.-a). This recommendation is echoed in academic studies, such as Costa, Arantes, and Tavares (2013) on the impacts of e-procurement application and Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan (2019) on the role of e-government in sustainable public procurement in developing countries. While the former study mentions boosted collaboration, integration of business processes, and promotion of GPP, the latter highlights the capacity of e-solutions in the public sector to address corruption caused by information asymmetry.

The interviews largely support these statements, because digital transformation is seen as an effective enabler for including horizontal policy goals, like greening, in the PP function (AU01; AU02; AU03; AU04; RK02; RK04; TN01; TN04; TN06). The formal, more administrative phases, such as tendering and award, are more static in nature and can be embedded as a sequence of industrialized processes (AU02), requiring less human interaction. In turn, digital transformation frees resources to strengthen the more qualitative tasks of the pre- and post-tender phases, such as screening markets for suitable suppliers and monitoring contract implementation to make sure that what is bought is delivered. Public value is created in these stages of public procurement, which contributes significantly to buying green as opposed to simply greening the process itself. In Korea automation makes public procurement more convenient, which enables greening because it frees up time and resources (RK02; RK04; RK06; RK07). Moreover, the entire public procurement market is monitored electronically, which supports the effective implementation of procurement policies (RK06).

As electronic markets are about to become the norm globally, it seems reasonable to include the transition to fully automated public procurement in any reform agenda. Reservations in this regard refer to implementation issues only. Specifically, in low-capacity countries, hurdles include insufficient infrastructure, unfavorable user-interface, and high internet user fees, weak data security, lack of capacity to use available e-services, and absence of native language options (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019). However, the degree and depth of digitalization and the level of development in a given country do not necessarily correlate. Even in advanced GPP countries, some sectors, such as handicrafts or farming, tend to have less affinity for information technology than others (AU02). At the same time, even some basic GPP countries, such as Romania, have well-functioning e-procurement systems. In these countries, e-procurement is a valuable tool for implementing GPP.

The following recommendations address how e-procurement can support primary PP objectives as well as a greening of the PP function.

1. Most important, in order to yield the benefits associated with digitalization of the PP function, the implementation of electronic solutions should be accompanied by a reengineering of the whole PP process and not simply mirror manually handled paper-based processes. This reengineering makes it possible to redirect human resources to the stages where they add the most value in terms of achieving societal goals, such as environmental protection (EBRD 2015; OECD n.d.-a; AU02).
2. Certain e-procurement elements and tools are especially helpful in terms of greening: in the preparatory stage, which can be optimized by being electronically supported, state-of-the-art artificial intelligence solutions could be employed, allowing for large-scale online research to identify markets and solutions, ultimately replacing time-consuming manual scanning for green works and products (AU02). In this vein, the Korean government plans to reorganize KONEPS using artificial intelligence and customized information per industry and region based on big data (RK06).
3. The goal of GPP is to buy green, which can only be evaluated if post-award data are available. Contract management and monitoring tools support the quality assurance process and facilitate the evaluation of whether what is written in the legal frameworks is actually implemented. This role not only is vital in developing the supply side but also provides policy makers with the data necessary to refine guidelines and identify the need for action. Experts are convinced that transparency creates trust, which is an important ingredient, as greening PP requires a high degree of collaboration (AU02; AU03; TN01; TN05).
4. In line with international standards,²⁷ all stakeholders need to have one single point of web-based access to PP information. A PP portal is considered one of the most important tools for generating competition and lowering the barrier for suppliers wishing to participate in

²⁷ Such as the World Trade Organization Agreement on Government Procurement, the 2011 UN Commission on International Trade Law Model Law on Public Procurement, and the OECD Recommendation on Public Procurement.

public tenders. It should be intuitive and user-friendly so that suppliers with basic internet literacy can handle the system easily. Furthermore, all public tenders and award decisions, including associated contracts, should be published, as is done in Korea (RK06). The formal criteria for participation should be harmonized for all suppliers, and registration should follow the “Once Only” principle (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019; EBRD 2015; OECD n.d.-a; AU02; KR05).

5. E-procurement design should be “modular, flexible, scalable, and secure in order to assure business continuity, privacy, and integrity, provide fair treatment, and protect sensitive data, while supplying the core capabilities and functions that allow business innovation” (OECD n.d.-a, 10). Any e-procurement tool should be designed such that it can be interfaced easily with other tools and a PP portal as well as with PMIS and IFMIS platforms (plug-and-play) (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019; EBRD 2015; OECD n.d.-a; AU02).
6. Any e-procurement reform should address the challenges that hinder buying from local and remote small and medium enterprises (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019; EBRD 2015; RK03; RK07). To improve the participation in PP of local, remote small and medium enterprises that are not fully e-enabled, regional cooperation could help to ensure proximity to suppliers. Moreover, to support local firms in developing countries to compete in public tendering, setting a quota of public contracts for local firms and centers with free wifi access could be considered (Adjei-Bamfo, Maloreh-Nyamekye, and Ahenkan 2019; AU02; AU04). Korea has a government procurement call center that supports small businesses in participating in the bidding through KONEPS. The call center provides support for difficulties related to use of the program, explains regulations, and responds to questions (RK06).

6.3.3. LCC can be helpful but is not crucial for greening

While some participants argued that (conventional) LCC plays a vital part in greening the PP function (AU02; TN02; TN04), others viewed it as a “marketing tool” to make a business case for GPP (TN01; TN06). Hence, the evidence regarding hypothesis H3c is mixed. In the following, it is argued that the main issue with LCC in the context of GPP is a structural one.

In the spirit of a TCO (conventional LCC), LCC only makes sense for product groups that have follow-up costs, as this is where a conventional LCC shows the financial advantages of green products, services, and works (Öko-Institut e.V. 2007; AU02). However, when post-acquisition costs are negligible, which is the case for food, paper products, electricity, and clothing, the greener product, service, or work does not generate financial benefits that accrue directly to the public buyer (Albano and Sparro 2010). In this case, the purchase price either correlates with the LCC or is higher for the environmentally friendly option. As a result, LCC does not enable GPP implementation. In addition, if buying green is more expensive, other necessary items cannot be purchased, as is typically the case for public sector entities facing budget constraints. In the worst case, buying green could compromise the entity’s ability to deliver public services of consistent quality.

This research clearly shows that the higher price—whether actual or perceived—of ecofriendly products, works, and services is by far the biggest obstacle for GPP implementation (AU01; AU02; AU03; TN03; TN05). This hurdle cannot be overcome by applying LCC, nor can it be solved solely at the level of procurement.

Moreover, even where conventional LCC serves its purpose and makes transparent the financial gains over the life cycle of a sustainable purchase, LCC only provides a potential justification for the buying decision. The purchase price might still be higher and more budgetary means might be required in the short run, which relevant stakeholders need to be willing to accept (TN03). With very few exceptions around the globe (for example, the United Kingdom), budget allocation decisions are not taken on the basis of costs, but on the basis of expenditures, which are two fundamentally different and nonaligned rationales. If cost accounting does not equally inform budget planning and budget allocation processes, this structural break is not manageable at the level of budget execution; in such an environment, procurers do not need to be convinced, but those who allocate the budget do (TN05). Procurers need to be enabled to conduct GPP, which requires financial means and a strong incentive or legal provision.

The structural issue touches on the core problem with GPP implementation and must be viewed from a systemic PFM perspective, as indicated by the OECD's recommendation to introduce financial, budgeting, and accounting measures to ensure that public procurement policies and practices consider the environmental costs of products and services. GPP is not a singular measure (TN01; TN03); it has to be seen in the context of a specific PFM environment. A shift in paradigm is required with respect to greening PFM practice as a whole toward a cost-sensitive system that allows for climate-informed decision-making. In that vein, the following measures are recommended.

1. Cost accounting is still rather underdeveloped in the public sector, although the concept of “cost” is of high relevance in managing public funds: not only does it increase the visibility of the cost of public service delivery, but it ultimately informs public financial sustainability strategies (Mohr 2019, 149). From a PFM perspective, the application of cost management principles in PP, such as LCC, seems advisable with a view to enhancing sustainability, as it helps to push down “sustainable financial decision-making into the organization” (Mohr 2019, 149). However, bearing in mind the numerous challenges in applying a fairly complex accounting technique such as LCC (de Giacomo et al. 2019; Iraldo, Nucci, and de Giacomo 2016), a certain pragmatism is indicated (AU02). One option is to focus on relevant direct life cycle costs and to forgo the monetization of external effects (AU02), as indicated by the conventional LCC method. Most important, for LCC to support GPP implementation, the data and evidence generated in the costing process provide vital information (Albano and Sparro 2010) and should be integrated with (multiannual) budget planning and forecasting.
2. For those product, service, or work groups with significant post-acquisition costs (which are among the drivers of CO₂ emissions), the application of conventional LCC not only could be institutionalized in the policy framework but also made a legal requirement on which to base purchasing decisions. In these cases, life cycle costing can be an important means to demonstrate the best use of taxpayer's money. Empirical evidence, based on

studies carried out in 2009 and 2011 in EU countries, points to savings in total costs that can be generated when life cycle-related or operating costs are considered in public tenders: an average 1.2 percent reduction in life cycle costs and 25 percent reduction in CO₂ emissions could be achieved, while half of the respondents reported that costs remained constant or fell when green solutions were chosen in the PP process (EC and ICLEI 2016). This could be one path for reducing PP decisions based on the lowest purchase price and for minimizing the dilemma for procurers. However, to ensure a level playing field and create legal certainty, LCC calculators, methodological tools, and guidelines should be made available.

3. Small public agencies often underestimate the positive externalities of buying green, which adversely affects their sustainable purchasing decisions: “A buyer caring about her own utility only will not be willing to pay a higher price in order to bring a positive externality (or avoid a negative one) to society” (Albano and Sparro 2010, 14), which is where centralized procurement arrangements come into play. By aggregating demand for environmentally friendly solutions, a bigger fraction of the overall reduction in negative externalities can be reaped, revealing clearly the societal advantages of green sourcing decisions. In addition, lack of expertise is typically regarded as a barrier to the application of life cycle costing, a challenge that is exacerbated in decentralized settings characterized by smaller purchasing entities and low-capacity environments. The pooling of resources, sharing of knowledge, and high degree of professionalization are distinctive features of centralized procurement agencies, which can provide a way forward in addressing the challenges (Albano and Sparro 2010; Öko-Institut e.V. 2007).
4. Third-party eco-labeling is a voluntary method used to certify environmental performance of a product, service, work, or supplier. It can be included in public tendering as part of the technical specification or award criteria and is an efficient alternative for incorporating the principles of life cycle thinking into public procurement (AU04; RK02; RK05; RK06). In Korea, the Eco-label certification system is fundamental for GPP, as it has made a large contribution to greening the procurement function (RK03; RK04). Moreover, according to the Act on Contracts to Which the State Is a Party, a “limited competition system” only allows those products certified by the Eco-label to join the public bidding (RK06). “By providing means of third-party verification, labels can help to save time while ensuring that high environmental standards are applied in public procurement” (EC and ICLEI 2016, 37).²⁸ This assurance seems particularly relevant for less mature PFM systems with low capacity as well as a fragmented and decentralized procurement function.
5. From a systematic point of view, GPP as a singular measure will not succeed if there is no minimum integration with the budgetary phase. One option is to integrate budget planning and execution structurally by shifting the financial paradigm to a cost-sensitive system. Another is to include in the GPP reform budget not only expenditure in direct relation to GPP implementation but also a higher budget allocation for PP to cover higher expenditure in the short run.

²⁸ In this regard, the scope of green products available should not be too narrow (RK07), and receiving a label should not be too easy (RL01).

7. Conclusions

The public financial management environment is crucial for greening the public procurement function. Certain systemic hurdles have to be overcome in order to mainstream eco-friendly considerations into public procurement.

First, reforms to the PP system need to be addressed through a comprehensive change process. Public procurement is part of the PFM function—consequently, it should be viewed as such and not just as a legal or business matter. The GPP endeavor should be planned along the various steps of administrative reform, as depicted in a classic policy implementation cycle. Merely changing the provisions without a proper implementation process will lead to failure. Moreover, the process has to include all relevant stakeholders—buyers and suppliers alike—as well as the whole supply chain, as GPP should be introduced in tandem with markets and met with goodwill and conviction from buying institutions.

Second, effective implementation of GPP requires central coordination efforts, even in highly decentralized PP environments. GPP implementation will most likely be very difficult in fully decentralized environments unless a high e-procurement system is available and equipped to tackle this challenge. A minimum “degree of centralization” is necessary to green the PP function—that is, the public sector needs to face the market in a coordinated manner in order to unravel its full potential market power, drive markets in a more sustainable direction, incentivize greener production, and pool the necessary expertise.

Third, budget planning needs to be aligned with budget execution. Substantial consideration should be given to integrating budget planning processes and budget execution in the case of GPP. The (perceived or actual) higher purchase price for eco-friendly products, works, and services is the biggest obstacle for GPP implementation. This challenge cannot be solved at the level of procurement because it affects budget allocation decisions. One option is to integrate budget planning and execution structurally by shifting the financial paradigm to a cost-sensitive system: with very few exceptions around the globe (for example, the United Kingdom), budget allocation decisions are not taken on the basis of costs, but on the basis of expenditure, which are two fundamentally different and nonaligned rationales. Ideally, cost accounting equally informs budget planning and budget execution. At the very least, the GPP reform budget should include not only expenditure in direct relation to GPP implementation but also higher allocations for PP to cover higher expenditure in the short run.

From a systemic PFM point of view, GPP as a singular measure will struggle to succeed in the absence of a minimum integration with the budgetary phase. If a government ultimately wants (and is required) to reduce its CO₂ emissions, it should embrace a more holistic approach and consider greening the broader PFM cycle. The necessary tools are being developed by the international (research) community, including, in addition to GPP indicators, measures such as CO₂ budgeting (accompanied by life cycle analysis or carbon footprint methodology in the budget implementation phase), budget tagging, environmental financial accounting and reporting, and green public auditing, some of which are already being implemented. These instruments help to generate information on negative environmental externalities caused by public sector activities as

well as on the financial and other impacts of climate change, enabling governments to make climate-informed decisions.

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Appendix A: Interviews conducted

Table A.1: Interviews conducted in Austria

ID	Organization interviewed	Name and function of interviewee	Date of interview
AU01	Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie der Republik Österreich (BMK)	Karin Hiller, naBe coordinator, Stellvertreterin des Abteilungsleiters	January 11, 2021
AU02	Bundesbeschaffung GmbH (BBG)	Jürgen Jonke, Bereichsleiter strategische Beschaffung	January 14, 2021
		Stefan Wurm, head, communications	January 19, 2021
		Markus Hof, head, Kompetenzzentrum, gesellschaftspolitische Beschaffungsziele	
		Gerhard Weiner, head, Plattform Nachhaltige Beschaffung	
	Uwe Flach, head, consulting and international affairs	January 21, 2021	
AU03	Bundesministerium für Finanzen der Republik Österreich (BMF)	Jakob Köhler, coordinator, Abteilung Beschaffung und Infrastruktur BBG	January 22, 2021
AU04	Vorarlberger Gemeindeverband, ÖkoBeschaffungsService (ÖBS)	Dietmar Lenz, head, ÖBS	January 22, 2021

Table A.2: Interviews conducted in the Republic of Korea

ID	Organization interviewed	Name and position of interviewee	Date of interview
RK01	Busan Metropolitan City	Young-shin Ahn, deputy director, Environmental Policy Division	March 3, 2021
RK02	Korea Environmental Industry and Technology Institute (KEITI)	Hong-seok Kim, senior research fellow, Sustainable Lifestyle Office Sang-hoon Park, researcher, Sustainable Lifestyle Office Hyun-Hee Lee, senior researcher, Green Transition Support Division	January 28, 2021
RK03	Korea Green Purchasing Network (KGPN)	Jee-An Yang, chief of KGPN	January 28, 2021
RK04	Korea Institute of Procurement (KIP)	Sanghoon Lee, senior research fellow	January 27, 2021
RK05	Ministry of Environment	Yu-Kyung, Lee, assistant deputy director, Environmental Education Team	March 10, 2021
RK06	Public Procurement Service (PPS)	Byung-Chul Lee, deputy director, Procurement Management Division Hae-Young Lim, deputy director, e-Procurement Planning Division	January 29, 2021
RK07	Local Governments for Sustainability and Public Procurement Analysis (ICLEI) Korea	Yeon-Hee Park, executive director, ICLEI, Korea Office	February 1, 2021

Table A.3: Interviews conducted in the Netherlands

ID	Organization interviewed	Name and position of interviewee	Date of interview
TN01	Foundation for Climate Friendly Procurement and Business (SKAO)	Maud Vastbinder, project manager, research and innovation	January 20, 2021
TN02	Netherlands Enterprise Agency (RVO)	Selina Roskam, knowledge broker for sustainable construction	February 9, 2021
TN03	Professional and Innovative Tendering Network for Government Contracting Authorities (PIANOO)	Floris den Boer, coordinating adviser	January 14, 2021
TN04	Rijkswaterstaat (RWS)	Jasper Flapper, senior adviser for sustainable procurement	February 18, 2021
TN05	Rijkswaterstaat (RWS)	Cuno van Geet, strategic policy adviser for circular procurement	February 4, 2021
TN06	Utrecht University, Copernicus Institute of Sustainable Development	Anne Rainville, assistant professor	January 27, 2021

Appendix B: Studies quantifying the effect of GPP measures on CO₂ emissions

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
Alvarez and Rubio 2015	Analysis of a green conservation and maintenance service of an urban waterfront and riverside over two years (2011–12)	Carbon footprint (CF) analysis: compound method using financial accounts to calculate both product and corporate CF in a comprehensive assessment	<p>The CF is about 41% higher for 2012 than for 2011 due to higher consumption and higher consumption intensity.</p> <p>The increase in total intensity is due mainly to the increase in scope 3 intensity: scope 3 emissions, mainly from materials, are the largest source of emissions in this study (59%).</p>	It is possible to conduct a CF analysis for conservation and maintenance services without too much effort and on a regular basis. Therefore, governments should require reports and verification of CF assessment in public procurement (PP). Energy intensity requirements should be included, such as the allowance for greenhouse gas emissions per euro. This information would allow government authorities to evaluate carbon intensity regularly and to draw up specific recommendations. The study also highlights the importance of recognizing scope 3 emissions within the context of climate change policy.
Anthonissen et al. 2015	Analysis of the Carbon Free Ways pilot project, which sought to stimulate carbon dioxide (CO ₂)-efficient working methods for road construction in Flanders. This pilot project included basic environmental parameters in the award criteria for public tenders on road works. The	Development of a “Carbon Counter” and a “Traffic Tool” to estimate emissions from the production and transport of raw materials and asphalt. The Carbon Counter estimates emissions from the production of raw materials by multiplying the mass by a default emission conversion	It is possible to reduce emissions significantly in a public road construction tender when environmental award criteria are included (the effect is not exactly quantified, however).	The application of green public procurement (GPP) for road works proved difficult because the inclusion of environmental award criteria in a public tender was new for Flanders. Nevertheless, the pilot project constituted a good first attempt at detecting significant and insignificant parameters and

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
	winning tender was the one with the best scores for price and CO ₂ emissions.	factor in ton of CO ₂ per ton of material, derived from the Inventory of Carbon and Energy (a database of energy and carbon in building materials). ^a The Traffic Tool calculates the additional amount of CO ₂ emitted by users of a particular road section and traffic diversions during road works.		collecting data for implementing GPP in this sector.
Bortolini et al. 2016	Design of a distribution planner for fresh food that considers three objectives: operating costs, carbon footprint, and delivery time. This planner is applied to a case study: the distribution of fresh fruits and vegetables from Italian producers to several European retailers.	A linear programming model that takes into account three typical food distribution constraints ("objectives"): food quality dependent on delivery time, geographically distributed market demand, and farmer production capacities	The planner can decrease CO ₂ emissions by 9.6%, although this leads to a 2.7% cost increase. Optimizing one objective leads to a significant worsening of the other two.	Applying a multiple-objective perspective to a distribution planner for fresh food in Italy can decrease CO ₂ emissions with a small increase in cost and an adequate increase in delivery time.
Cerutti et al. 2016	Analysis of the impact on greenhouse gas emissions of three food policies implemented in a school catering service in an Italian city	CF analysis of the three phases of the supply chain in the catering service: production, provisioning, and distribution	Most greenhouse gases are emitted in the production phase. The requirement of organic or integrated production reduced the CF associated with production by 32% compared to conventional production. ^b Requirements for regional provisioning of five products considered in the analysis led to a 33% reduction of greenhouse gas emissions compared to the previous	Policies that affect the production phase have the greatest potential to reduce the carbon footprint of the catering service. Providing organic and regional food has a higher impact on greenhouse gas reduction than shifting to greener vehicles.

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
			<p>year's emissions for the same phase of the supply chain.</p> <p>The shift from petrol motor vehicles to natural gas vehicles in urban food distribution does not reduce greenhouse gas emissions due to the high traction efficiency of petrol motors and the high performance of particulate removal of new-generation filters.</p>	
Cerutti et al. 2018	Analysis of the impact of 11 GPP measures using a school catering service as a case study	CF analysis comparing 11 GPP measures to a baseline scenario of "no measure" to quantify the impact of the measures on greenhouse gas emissions	A vegetarian diet reduces CF by 32%. Shifting to the exclusive use of organic food can potentially reduce CF by 11%. The adoption of energy-efficient appliances, coupled with the shift to a different power grid mix for electricity, can lead to a potential overall reduction of CF of around 7.8%.	<p>The most effective GPP measure is the change to a vegetarian diet in this specific catering service.</p> <p>The impact on emissions depends on the specific GPP measure implemented in the catering service sector.</p>
EC and ICLEI 2016 ^c	A summary of GPP measures in different European Union (EU) countries that have helped to curb emissions: (1) Norway: procurement of an electric ferry in Norway. (2) Sweden: joint procurement of electric vehicles in Sweden. (3) Finland: an energy performance contract for municipality buildings in Vantaa. (4) Romania:	Does not go into methodological details	(1) Norway: annual reduction of CO ₂ emissions of 89%. (2) Sweden: 95% emissions reduction. (3) Finland: a cut in emissions of 7,500 tons of CO ₂ annually. (4) Romania: "considerably" lower greenhouse gas emissions compared to previous diesel buses. (5) Slovenia: a decrease in CO ₂ emissions associated with the specification for	Same conclusion as that of Ministry of the Environment, Denmark (2013): These case studies on green tenders illustrate the potential for GPP to reduce emissions. However, it seems likely that only successful GPP measures are described, which leads to the question, Are other examples not so successful?

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
	procurement of greener buses. (5) Slovenia: Public Procurement Agency tenders for road transport vehicles specifying that all vehicles must meet the latest Euro emissions standard or equivalent and not exceed certain maximum CO ₂ emissions levels. (6) Croatia: a municipality that published an open tender for new fixed street lighting with LED lighting. (7) Austria: tendering for greener electrical goods.		vehicles ranging from 3 grams per kilometer to 45 grams per kilometer per vehicle. (6) Croatia: a 36% reduction in CO ₂ emissions per year. (7) Austria: a 20% reduction in CO ₂ emissions compared to the previous tender	
Gröger, Stratmann, and Brommer 2015 ^c	Comparison of green to conventional procurement with regard to greenhouse gases for 15 product groups in Germany	Comparison of conventional to green PP by means of life cycle analysis (LCA)	Emissions reductions are as follows: 48% for refrigerating systems, 22% for office lighting, 45% for street lighting, 36% for cleaning systems, 42% for buildings, 47% for electrical energy, 17% for cars, 41% for machinery, 32% for computers, 47% for technical equipment, 15% for paper, 21% for dishwashers, 46% for textiles, 55% for floor cover, and a whopping 3,074% for industrial waste. Overall, greenhouse gas emissions are reduced by 47% (CO ₂ equivalent). Green electricity, energy-saving housing, use of LED lamps in street lighting, and	(1) The proposed measures to reduce CO ₂ emissions should also be implemented in product groups and services with small contract values, as doing so puts less strain on the environment. (2) Green electricity has the most potential for curbing CO ₂ emissions; however, this does not mean that no efforts should be made to reduce energy overall.

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
			<p>recycling of industrial waste have the most potential to reduce CO₂ emissions.</p> <p>Considering the full volume, the positive impacts of cost savings in the 10 cheaper product groups outweigh the negative impacts of the 5 more expensive product groups. Looking at the whole life cycle, 10 product groups are cheaper when procured green; 5 product groups are more expensive.</p>	
Jungbluth, Keller, and König 2016	<p>Analysis of the environmental impact of about 20 million meals served in 240 canteens in 2011. Improvement options for canteens focused, for example, on air-transported products, green electricity, energy-efficient lighting, cooling, ventilation, and cooking devices, food waste per meal, and greener cleaning equipment. The results were used to develop a program to assist companies that commission the operation of canteens on their premises to improve their environmental performance. The program aims for a 20% cut in greenhouse gas emissions</p>	<p>Full organizational LCA for 160 food items linked to the food amounts of about 10,000 articles purchased in 2011, supplemented by data on canteen operation</p>	<p>According to the World Wildlife Fund, the program led to a reduction of CO₂ emissions of 3% between 2015 and 2018; emissions reductions between 2012 and 2015 were higher.^d</p>	<p>GPP has a lot of potential in the agricultural step and should focus on reducing the production of meat and poultry products. Also, it is not possible to achieve a substantial reduction of environmental impacts caused by canteens without taking other stakeholders on board.</p> <p>The program started out successfully, but there is no long-term evaluation at the time of writing; thus, it is not clear whether the 20% target has been met.</p>

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
Larsen and Hertwich 2010	after full implementation in the participating canteens. Analysis of greenhouse gas emissions resulting from municipal activities (provision of preschool, elementary, and secondary schooling, health care, water supply, sewage and garbage collection, cultural and sporting activities, and the maintenance of municipal roads and buildings).	CF analysis of municipal activities	Municipalities contribute about 5% to the total CF in Norway (private consumption contributes the most, at 78%). CF calculations of different schools show that the CF ranges between 200 and 500 kilograms of CO ₂ equivalents. The model illustrates that including indirect emissions in the calculation of CO ₂ equivalents leads to a large increase in CO ₂ equivalents.	It is important to include indirect emissions in CO ₂ inventories. The wide range of CF for different schools implies that there is much potential for GPP in educational services in Norwegian municipalities. With such measures, CF can be more than halved.
Ministry of the Environment, Denmark 2013 ^c	Description of two Danish projects to reduce emissions: (1) a tender for a new chemical-free cleaning system in a Danish municipality and (2) delivery of reused bricks for construction of the first Danish eco-labeled kindergarten in Odense Municipality	Does not describe the methodology	Case study 1: CO ₂ emissions are reduced by almost 70% compared to traditional cleaning methods. The main reason for the improved climate performance is the use of fewer mops, which also weigh less and have a longer life span than “traditional” mops. Case study 2: 1 ton of CO ₂ is saved each time 2,000 bricks are recycled (thus far, 30,000 bricks have been supplied, which has saved 15 tons of CO ₂).	GPP has potential to reduce emissions. However, it seems likely that the government only describes successful GPP measures, which leads to the question, Are other samples not so successful?
Pricewaterhouse Coopers,	Monitoring of GPP in the seven best-performing EU member states (Austria,	Analysis based on answers to a digital questionnaire among 2,907 contracting authorities	GPP contributed to an average reduction of CO ₂ emissions of 25% in 2006—for 10 product	The impact of GPP on emissions is significant; however, the study does not use a full LCA. Emissions

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
Significant, and Ecofys 2009 ^c	Denmark, Finland, Germany, the Netherlands, Sweden, and the United Kingdom). The study measures the number and value of “green” contracts and compares them to the overall number and value of PP contracts. It also measures the CO ₂ and financial impacts of GPP in the EU member states.	in the 7 countries (response rate 38%) and selection of 10 product groups frequently procured by public institutions. Respondents were asked to indicate whether their most recent purchasing contracts complied with certain green criteria. To measure impact on emissions, the study uses a “CO ₂ ratio,” which determines the CO ₂ impact of GPP per functional unit of a product group. Linking this product to CO ₂ results by procurement value indicates the CO ₂ impact of GPP in 2006–07.	groups. The average impact on CO ₂ emission reductions in 2006–07 ranged from 9% in Germany to 47% in the Netherlands, depending on the country-specific levels of GPP per product group. For most product groups, GPP resulted in a reduction of CO ₂ emissions, with construction, gardening, paper, and textiles attaining the highest reductions.	reduction varies a lot between countries.
Pulkkinen et al. 2016	Quantitative assessment of the impact of lunches on climate change: How can lunches be designed such that they reduce emissions?	A climate-friendly lunch meal concept based on a simplified CF of raw material production and processing of ingredients for 105 commonly selected lunches. Three restaurant operators (25 restaurants in total) were involved in the pilot.	If lunch meals are designed in a climate-friendly way, their emissions can be reduced by 15% to 30%. The maximum climate change impact of a “Climate Choice” meal, which consists almost exclusively of vegetarian ingredients, is 0.8 kilogram of CO ₂ equivalents; the maximum impact of a “Better Climate Choice” meal, also mainly vegetarian, is 0.65 kilogram of CO ₂ equivalents.	Providing vegetarian lunch meals rather than lunch meals containing meat has a lot of potential to reduce CO ₂ emissions.
Rietbergen and Blok 2013 ^e	Analysis of the impact of the CO ₂ performance ladder on emissions in the Netherlands,	Analysis of CO ₂ emission inventories from 170 companies for 2010	Since introduction of the CO ₂ performance ladder, scope 1 CO ₂ emissions were reduced by 3.5%, scope 2 emissions by	It is important to include indirect (scope 3) emissions in emissions calculations.

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
	mainly in the construction sector		12.6%, and scope 3 emissions by 18.6%. Total emissions between 2009 and 2010 were reduced by 7.8%.	
Trovato, Nocera, and Giuffrida 2020	Evaluation of an energy retrofit that includes sustainable low-CO ₂ emission strategies, such as double-glazed wooden windows, organic external wall insulation systems, and green roofs for a public building in a Mediterranean area.	Integration of LCA into a standard economic financial evaluation of an energy retrofit project for a public building	A retrofit of buildings with sustainable low-CO ₂ emission strategies can reduce energy needs for heating and cooling by 58.5% and 33.4%, respectively. The use of sustainable materials reduces a building's CF index by 54.1% after retrofit compared to the use of standard materials.	Implementation of less profitable but more environmentally efficient retrofitting should be encouraged.
UNEP 2019	Analysis of reductions of CO ₂ emissions due to Korea's GPP policy; analysis for 19 product categories of the Korea Ecos-label. Data were collected from all public authorities targeted in the Sustainable Public Procurement (SPP) Policy via KONEPS (Korea ON-line E-Procurement System), KEITI (Korea Environmental Industry and Technology Institute), and GPIS-I (Green Procurement Information System). In addition, the impact of the SPP policies of select public authorities in Japan, the Netherlands, and	Calculations comparing Eco-labeled products with conventional products using LCA data. The CO ₂ savings calculation formula used in Japan is as follows: total number of products purchased during the year x (% that is green - % of market share of the green product in 2000) x conversion factors of the green product characteristics to CO ₂ -equivalent emissions x years of use of the product. In Massachusetts, various calculation tools are used. In the Netherlands, calculations are for product categories	(1) Korea: the CO ₂ -equivalent emissions reduction factor for the life cycle of a product ranged from 61.8 to 1,000 per unit of production for electrical and electronic goods. For construction materials, office furniture, and hygienic materials, it ranged from 0.0005 to 8.526 per kilogram. (2) Japan: savings of 175,565 tons of CO ₂ across all of the years measured. (3) Massachusetts: savings of 154,551 tons of CO ₂ in 2016. (4) the Netherlands: savings of 3.8 million tons of CO ₂ for electricity, 1.1 million tons for solar panels, 17,000 tons for	Different methodologies, data sources, and baselines are used between countries to compare green and conventional products; the definition of "green" is not the same across countries.

Source	GPP measure analyzed	Methodology used	Results (impact on CO ₂ and greenhouse gas emissions)	Implications of the results
	the US state of Massachusetts were measured.	related to transport, energy, and clothing.	transport services, and 6,000 tons for vehicles.	

a. Retrieved from <https://ghgprotocol.org/Third-Party-Databases/Bath-ICE>.

b. Integrated production is a knowledge-based approach to farming, based on maximizing natural control processes for pest and soil management and growing a healthy crop. It is a dynamic approach to moving toward sustainable farming systems, introduced in steps up the integrated production “ladder.” See <https://www.pan-europe.info/campaigns/agriculture/integrated-production>.

c. Not a peer-reviewed study.

d. Retrieved from <https://www.wwf.ch/de/partner/partnerschaft-sv-schweiz-ag-2018>.

e. The paper suffers from several shortcomings, which the authors acknowledge. For example, it does not have long-term data, and it cannot attribute how much of the reduction in emissions is actually due to the ladder, or due to other factors.

Appendix C: GPP uptake by country

Table C.1: Green public procurement (GPP) uptake in Africa and Oceania

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Australia	<p>The Commonwealth Procurement Rules require that tenders be evaluated based on relevant financial and nonfinancial costs and benefits, which include, among other factors, environmental sustainability of the proposed goods and services. The Australian state, territory, and local governments are subject to GPP policies. Each state has environmental procurement policies and guidelines as well as web tools to increase awareness and expertise regarding low-impact options. The Environment Protection and Biodiversity Conservation Act 1999 requires government agencies to include in their annual reports information about their performance in following ecologically sustainable development principles (Hasanbeigi, Becqué, and Springer 2019).</p>	<p>Australian states are at varying stages of developing GPP policies and implementing strategies to meet GPP objectives. State procurement boards are engaged in advising procuring authorities on the environmental attributes of products and integrating performance targets into procurement decision-making. Several states have included environmental standards in supplier prequalification schemes and listings.</p> <p>The government's ECO-Buy Local Program is working to improve tracking and reporting of expenditures for green products. As a result, local authorities report improvement in buying green. In 2008, 49% of ECO-Buy members had a tracking system in place, and, in 2009–10, 65% of ECO-Buy members were informed about green purchasing. GPP performance certificates are awarded. Between 2000 and 2009, the number of green products purchased grew from 80 to more than 430. More than 37,500 tons of carbon dioxide (CO₂) were avoided. In 2009–10, 77% of ECO-Buy members were making good progress in developing GPP policies and strategies.</p> <p>Australia has potential to exceed both its 2020 emissions target (5% below 2000 levels) and its 2030 emissions target (26–</p>	<p>In 2019 Australia was expected to meet and exceed its targets for 2020 and 2030 (Department of Environment and Energy, Australia 2019). However, states are at varying stages of implementation, which implies that some states have progressed little in implementing GPP. Not all states report on green purchasing, and the procurement of green products is difficult to monitor (Hasanbeigi, Becqué, and Springer (2019).</p> <p>→ GPP gap country</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Côte d'Ivoire	There are no dedicated sustainable public procurement (SPP) or GPP policies in place and no SPP or GPP provisions in existing procurement regulations. However, some preparatory work is being done to facilitate the implementation of sustainable procurement in the government. A reform of environmental taxation has been launched (UNEP 2017b). However, as of April 2020, evaluation criteria were based solely on economic, financial, and technical criteria according to Article 72 of the Government Procurement Code (Chambers and Partners 2020).	28% below 2005 levels) (Hasanbeigi, Becqué, and Springer 2019). There is no information on GPP uptake.	No implementation gap exists because no policies and no targets have been set. → Basic GPP country
Nigeria	GPP is not part of any legal framework, despite the existence of a Public Procurement Act enacted in 2007, which seeks to ensure the attainment of value-for-money, accountability, equal opportunity, and transparency in the award of public sector contracts. No GPP targets have been set (Akenroye, Oyegoke, and Eyo 2013).	GPP is not yet being implemented in Nigeria.	No implementation gap exists because no policies and no targets have been set. → Basic GPP country
South Africa	As of 2014, several South African provinces and towns have developed their own GPP policies. All public entities—national, provincial, and municipal as well as state-owned enterprises—are required to adhere to GPP principles. GPP aims to encourage a decrease in energy and resource use, promote environmental best practices	GPP uptake is difficult to measure because South Africa has 36 government supply chain management systems, and these are not automated and generally not well integrated (Hasanbeigi, Becqué, and Springer 2019). Implementation of GPP or SPP is still in its infancy: a range of efforts have been undertaken, with varying degrees of success, to move forward with	Since South Africa lacks both a clear, overarching strategy and a national legal framework, there is no implementation gap. Mutenda (2018) describes GPP in South Africa to be “at its infancy stage.” → Basic GPP country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	in terms of waste minimization and management, water and energy efficiency and conservation, pollution reduction, and socioeconomic development as well as to encourage suppliers to design, manufacture, and dispose of their products in a sustainable manner (Hasanbeigi, Becqué, and Springer 2019).	SPP activities in the absence of an overarching strategy or policy (Turley and Perera 2014).	

Table C.2: Green public procurement (GPP) uptake in Asia

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
China	China has adopted practices to implement GPP since 2004 (Zhu, Geng, and Sarkis 2013). GPP was also included in the 12th and 13th Five-Year Plans for National Economic and Social Development (Hasanbeigi, Becqué, and Springer 2019). GPP in China applies to all national, state, regional, and local public authorities. GPP is mandatory (UNEP 2019), and China has the largest total number of products certified for GPP globally (Hasanbeigi, Becqué, and Springer 2019). The policies do not set quantitative targets, but they establish that the scale of sustainable public procurement (SPP) should be widened (UNEP 2017b).	In 2013, 29% of all national-level public procurement institutions followed China's GPP regulations (Hasanbeigi, Becqué, and Springer 2019), of which 80% was procurement of energy-efficient and environmental labeling products. In 2012, 80% of provincial-level expenditures were for energy and water conservation products. In wealthier provinces with more effective GPP practices, 87% of procurement expenditures were for these types of products (Hasanbeigi, Becqué, and Springer 2019). In 2011, 14% of total public procurement (PP) expenditures were for green products and services (Hasanbeigi, Becqué, and Springer 2019). SPP training is provided annually (UNEP 2017b). Green public procurement is implemented primarily using a framework provided by eco-labels and energy labels (UNEP 2017b).	Evidence points to an implementation gap. Policies are in place, but only 29% of institutions follow them, and no quantitative targets have been set. Despite legal practices in place since 2004, effective GPP promotion remains a major challenge and barriers to GPP still exist (Zhu, Geng, and Sarkis 2013). → GPP gap country
India	There is no specific procurement legislation. In 2011 India's Ministry of Environment and Forests formed a committee to develop GPP guidelines, and in 2018 an SPP Task Force was created. Local governments, ministries, and government departments have undertaken GPP initiatives, but there is no coherent GPP strategy (Hasanbeigi, Becqué, and Springer 2019).	Local governments, ministries, and government departments have undertaken GPP initiatives. For example, Indian Railways undertook a unique initiative in 2008 to reduce peak lighting loads in its residential quarters by replacing incandescent lamps with energy-efficient lighting. In 1991 India launched a voluntary eco-labeling scheme (Eco-Mark) that focused on both environmental and product quality criteria; however, eco-labels and environmental standards are not commonly considered as part of public procurement of products, works, and services, and the Eco-Mark label has so far not been widely adopted by manufacturers or buyers. There	No implementation gap exists, as no specific GPP legislation is in place and no targets have been set. → Basic GPP country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Indonesia	There are no SPP provisions in overarching or thematic national policies and no dedicated SPP policies. SPP provisions in existing procurement regulations refer to the procurement of goods and services with environmental benefits (UNEP 2017b).	<p>are no estimates of the extent of GPP (Hasanbeigi, Becqué, and Springer 2019; UNFSS 2020).</p> <p>No information is available on GPP uptake. In 2020 an initiative was launched to accelerate the shift to GPP and SPP (IGPN 2020).</p>	<p>No implementation gap exists, as no specific GPP policy is in place and no GPP targets have been set.</p> <p>→ Basic GPP country</p>
Japan	Japan is a pioneer in developing a GPP framework (Hasanbeigi, Becqué, and Springer 2019), with policies and regulations to promote and implement GPP in place since the late 1980s. The Basic Policy for the Promotion of Procurement of Eco-Friendly Goods and Services requires that government agencies apply green purchasing criteria when procuring products in a wide array of categories. The Basic Policy Concerning the Promotion of Contracts Considering Reduction of Greenhouse Gas Emissions by the State and Other Entities requires government agencies and public institutions to follow green contracting requirements when purchasing electric power, automobiles, energy services, or building design services. The Act on Promoting Green Purchasing requires that each ministry's or agency's procurement policy include GPP considerations and targets (Hasanbeigi, Becqué, and Springer 2019). In 1994 the government of Japan published its action plan on green government operations, which included GPP commitments and reporting	<p>Japan has a well-established GPP monitoring system. Monitoring takes place at the central and local government levels. The Green Purchasing Network publishes green purchasing guidelines and maintains an online eco-products database of environmentally friendly products and services (Hasanbeigi, Becqué, and Springer 2019). Services related to GPP are being provided, such as GPP training sessions, networking events, and information resources (UNEP 2017b). The implementation of GPP in local governments and enterprises has been on the rise in recent years, reaching more than 68% for local governments and almost 58% for enterprises in 2015 (Ministry of the Environment, Japan 2017).</p> <p>GPP has reduced greenhouse gas emissions by an estimated 210,000 tons of carbon dioxide (CO₂) equivalents (Hasanbeigi, Becqué, and Springer 2019). In 2014, 95% of the goods and services purchased were eco-friendly. 63.2% of the electricity supply, 90.1% of purchased automobiles, and 68.3% of the building design were contracted</p>	<p>Japan has a long tradition of GPP, and GPP monitoring works well (100% response rate). Many services are being provided to GPP practitioners. The percentage of green products and services is very high (95%). The implementation gap is small and narrowing, and the GPP gap is very small or nonexistent.</p> <p>→ Advanced GPP country</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	requirements (UNEP 2019). GPP is mandatory.	through green contracts. In 2015 the response rate among agencies asked to provide information on SPP was 100%.	
Korea, Rep.	The Act on Development and Support of Environmental Technology of 1994 established GPP and the Eco-label. This act was complemented by the 2005 Act on Promotion of Purchase of Green Products, which requires all government sectors and offices to submit to the Ministry of Environment an annual green purchasing implementation plan for the current year as well as a performance report for the previous year. Each ministry sets its own GPP targets. Article 6 states that the heads of public authorities are obliged to purchase green products (KEITI n.d.)	Total green public purchases rose significantly within a few years following adoption of the Act on Promotion and Purchase of Green Products of 2005 and continues to increase. Korea Environmental Industry and Technology Institute (KEITI) evaluates the financial, environmental, and societal effects of GPP annually and publishes the rates for different green products and services that are procured (Hasanbeigi, Becqué, and Springer 2019). In 2018 rates ranged from almost 38% for purchases by local governments to more than 90% for purchases by market-based public enterprises. By product, vehicles perform the worst, at a little over 17%, while more than 86% of textile, rubber, sanitary, and leisure products and services are procured green (KEITI n.d.). On average, 50% of all products purchased are green (RK01). In 2019 Korea reported a reduction in CO ₂ emissions due to GPP activities of about 860,000 tons (KEITI n.d.). The process of aggregating performance results and producing statistics is also systematized (RK02).	Implementation is systematic and advanced compared to implementation in other countries (RK02). However, both the legal system and the regulations are well prepared, but “there exists definitely an implementation gap” (RK03). The objectives pursued in the GPP policy have not yet been achieved, but they are being achieved gradually (RK04). The implementation gap is large (RK07), as GPP is focused on purchasing green products, which are limited to the few product groups specified in the law (RK01). In addition, there are not enough support programs to encourage public institutions to practice GPP actively (RK07). Korea has a strong institutional framework for GPP implementation, based on the collaboration of key actors, such as KEITI, the Ministry of Economy and Finance, the Ministry of Environment, and PPS (Public Procurement Service) (UNEP 2019b). The framework is in line with the good practices reported in UNEP (2017c). Furthermore, Korea is one of the few countries to provide fiscal incentives for GPP implementation: high-performing local governments are rewarded with a larger budget, and public institutions receive a performance bonus.

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Lebanon	SPP provisions are included in existing procurement regulations, but no dedicated SPP policies are in place. SPP provisions exist in overarching or thematic national policies. In 2012 an SPP Action Plan was prepared, but climate change mitigation and emissions reduction are not a priority (UNEP 2017b). According to Democracy Reporting International (2020), “Lebanon’s public procurement is governed by an outdated and fragmented set of laws and decrees that enables corruption and clientelism,” and green and sustainable procurement practices have not yet been adopted.	The SPP action plan is a step toward implementing GPP (UNEP 2017b).	<p>No implementation gap exists, as no specific GPP policy is in place, and no GPP targets have been set.</p> <p>→ Advanced GPP country</p> <p>→ Basic GPP country</p>
Malaysia	SPP provisions exist in overarching or thematic national policies, and dedicated SPP policies are in place; however, there are no SPP provisions in existing procurement regulations (UNEP 2017b). Malaysia has set a goal that, by 2020, at least 20% of government procurement should be green. This goal covers all government agencies. The private sector is encouraged to follow the example set by the public sector (UNEP 2017a).	The Ministry of Finance started to raise awareness about GPP initiatives in 2014 (with a pilot project in five agencies). In 2016 GPP was expanded to other ministries and agencies. Capacity-building sessions are held for all ministries and agencies. In 2016–17, RM 4.88 million were allocated to developing green technology and green procurement (UNEP 2017b). GPP values under the pilot implementation project in 5 ministries or agencies are published (UNEP 2017b), but these values are not related to overall procurement value and, therefore, cannot be interpreted. The government monitors the level of GPP (outputs) for all targeted organizations in terms of GPP expenditure on the products and services prioritized in the action plan (UNEP 2020).	<p>SPP and GPP provisions exist, and GPP is on the government’s agenda. GPP targets have been set and are monitored. The number of federal ministries and agencies participating in GPP has increased from 5 in 2013–15 to 25 in 2018, and the number of green products and services registered has grown from 181 in 2013–15 to more than 3,000 in 2018 (UNEP 2020). Still, as Alqadami et al. (2020) argue, “The concept [of GPP] in Malaysia is still in its early stages and encounters barriers to make a paradigm shift towards a greener approach.”</p> <p>The implementation gap seems to be declining steadily.</p> <p>→ GPP gap country</p>
Mongolia	SPP provisions exist in overarching or thematic national policies; there are no	A Sustainable Public Procurement and Green Buildings Project was launched to improve	No implementation gap exists, as there are no GPP policies or GPP targets.

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	SPP provisions in existing procurement regulations and no dedicated SPP policies (UNEP 2017b).	the efficiency and effectiveness of the Mongolian PP process by incorporating sustainability aspects into the national PP framework. Since then, the Ministry of Finance has been collaborating with other ministries on development of an SPP National Action Plan. The project is in its final development stage (UNEP 2017b).	→ Basic GPP country
Singapore	SPP provisions exist in overarching or thematic national policies, and dedicated SPP policies are in place. However, no SPP provisions exist in procurement regulations. Lowering emissions and mitigating climate change are priorities. GPP guidelines were developed but have not yet been made publicly available. GPP criteria are based on existing national labeling schemes and voluntary sustainability standards. Their use is mandatory (UNEP 2017b, 2019). There are no GPP targets (UNEP 2017b).	The Public Sector Taking the Lead in Environmental Sustainability Initiative was introduced in 2006 and updated in 2014. Under this initiative, the government set green procurement requirements for information and communication technology equipment, electrical appliances, and paper products. Official events and functions must be held in venues with at least a Green Mark certified rating. The initiative is intended to raise the standards on sustainability, so that the public service can continue to lead in sustainability and climate action (Fu 2020). The Singapore government has developed eco-labels to encourage GPP (APEC 2013; Singapore Environmental Council 2014). Singapore is part of the International Green Purchasing Network (APEC 2013), which aims to promote the development of environmentally friendly products and services and green purchasing activities globally.	GPP policies have been developed, but no specific targets have been set, and there are no SPP provisions in procurement regulations. → GPP gap country
Thailand	Since 2005, the government has adopted SPP strategies, plans, and policies. GPP was introduced in 2005. Two plans have been developed since 2008 for the promotion and implementation of GPP. The GPP Promotion Plan of 2008–11 sought to increase government spending	The Pollution Control Department has initiated the implementation of GPP in the public sector and has carried out several activities under the GPP Promotion Plan, including training workshops and seminars for procurement staff and implementation of a voluntary monitoring system to assess the	Implementation and monitoring of GPP are voluntary, and there is a lack of cooperation on the implementation of green public procurement (UNEP 2017a). As a result, in 2012 only 40% of agencies submitted a procurement report to the Pollution Control Department. In 2016 all

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	<p>on environmentally preferable products and services. In the second GPP Promotion Plan 2013–16, the target groups were expanded to local authorities, private sector businesses, and the general public. GPP is conducted on a voluntary basis (UNEP 2017a).</p>	<p>progress. In 2015 Thailand reported a reduction in CO₂ emissions of around 26,000 tons due to GPP activities (UNEP 2017a). An electronic platform for monitoring and reporting is in place (UNEP 2017a).</p> <p>In its second national plan, Thailand set a goal for the central government of at least 90% GPP by 2016 (UNEP 2017a, 2017b).</p>	<p>central government agencies and a majority of other government agencies had implemented GPP (SwitchAsia n.d.). Hence, Thailand seems to be steadily closing the implementation gap.</p> <p>→ GPP gap country</p>

Table C.3: Green public procurement (GPP) uptake in Europe

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Austria	The 2006 Federal Act for Public Procurement contained Austria's first set of green procurement policies. In 2010 the National Action Plan (NAP) on Sustainable Procurement was developed with the aim of making GPP a key practice; however, the plan does not contain any quantitative targets.	<p>In 2006 Austria was among the top performers with regard to the uptake of GPP (Bouwer et al. 2006). In 2011, 50% of public authorities included GPP requirements in their procurement process; in 2012, 73% of public contracts included at least one core European Union (EU) GPP criterion (Hasanbeigi, Becqué, and Springer 2019). In 2008, 36% of government officials interviewed made use of GPP criteria "always" or "often," and 64% did so "sometimes" or "never" (Hasanbeigi, Becqué, and Springer 2019). Still, 53% of public tenders use price as the sole criterion for selecting offers (Hasanbeigi, Becqué, and Springer 2019).</p> <p>From 2005 to 2010, renewable energy sources associated with products procured rose from 40% to 100%, and the use of certified green electricity increased from 0% to 3%. Greenhouse gas emissions from electricity consumption declined during that time period, even though electricity consumption rose (OECD 2015).</p>	<p>Evidence points to a small implementation gap. Although more than half of public tenders still use price as the sole criterion for selecting offers, a majority of public authorities include EU GPP core criteria in public contracts. The 50% target set by the EU has been met. Austria is among the top third of European countries (AU02).</p> <p>→ Advanced GPP country</p>
Belgium	Sustainable public procurement (SPP) including green provisions exist in overarching or thematic national policies and in existing procurement regulations; dedicated SPP policies are in place (UNEP 2017b). The Flemish government introduced GPP in 2014. The program covers 19 product groups and a range of subgroups with a target of 100% sustainable public purchasing by 2020. Mandatory criteria have been developed for several product groups (Hasanbeigi, Becqué, and Springer 2019). There are no	<p>For materials used to renovate buildings, a guidance document has been published that suggests considerations for procurers and describes criteria that could be applied. Since 2014, every supplier of construction material in Belgium that claims certain environmental attributes for its products has to provide an environmental products declaration based on life cycle analysis (LCA).</p> <p>Support tools are in place at the regional and federal levels, such as a help desk for e-procurement and guidelines on green and</p>	<p>The implementation gap is small. The 50% target set by the EU and the country's own targets, where they exist, have been met. However, GPP uptake could be higher if more parts of the country would set quantitative targets.</p> <p>→ Advanced GPP country</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	green targets at the federal level. By 2017, at least 20% of public procurement (PP) in Brussels is to include environmental criteria; in Flanders, all PP will be sustainable by 2020; in Wallonia, there is no target (UNEP 2017b).	social PP. The adoption of e-procurement is advancing, with e-notification for contracts above EU thresholds being mandatory since 2013 for all levels (federal, regional, and local), and mandatory e-submission being phased in over time starting with federal authorities in 2012. E-auction, e-awarding, and e-catalog have been available since 2011 (EC n.d.-b). In 2009–10 Belgium was one of the top performers in green procurement, with green criteria applied in 40% to 60% of cases (Hasanbeigi, Becqué, and Springer 2019).	
Bulgaria	Bulgaria’s PP strategy includes efforts in GPP. The GPP NAP for the period 2012–14 focused primarily on fostering awareness, but compulsory requirements were introduced for a set of product categories. The government plans to strengthen environmental considerations through cooperation with leading countries as well as the introduction of guidance in the form of a handbook (EC n.d.-b).	The Public Procurement Agency is involved in training on GPP topics (EC n.d.-b). The level of GPP uptake was less than 20% in 2009–10 (EU 2012), making Bulgaria one of the worst-performing GPP countries.	There is evidence of an implementation gap. Bulgaria has a strategy for GPP, but implementation of this strategy is lagging, as indicated by its “plans” to strengthen environmental considerations. The 50% target set by the EU has not been met.
Croatia	SPP provisions exist in overarching or thematic national policies and in existing procurement regulations; dedicated SPP policies are in place. A GPP action plan was approved in 2015. It sets the overall objective of 50% of all public contracts to include environmental criteria by 2020 for priority product categories. Even though the GPP NAP is voluntary, if public authorities introduce green criteria in their tenders, the use of these criteria is mandatory (UNEP 2017b).	The United Nations Development Programme, which is a key support institution in implementing Croatia’s GPP 2020 initiative, offers a help desk to support contracting authorities looking to incorporate green and low-carbon-intensity procurement practices. They also disseminate GPP 2020 best practices via a database of educational and training materials, workshops, and GPP events. The Croatian government is pursuing various means to promote environmentally friendly policy goals via its procurement system. The Public Procurement Act of 2012 promotes the voluntary use of environmental certifications	There is evidence of an implementation gap. Policies exist, but GPP uptake is low (one year after implementation of the GPP NAP, only 0.2% of contracts included green criteria). The 50% target set by the EU has not been met. → GPP gap country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Cyprus	<p>The GPP NAP adopted in 2012 sets several specific measures to promote environmental criteria in tendering processes (EC n.d.-b). The GPP NAP is mandatory for state authorities, public organizations, and local authorities. The target for most product categories is for 50% of contracts to be green (Georgiou 2018).</p>	<p>and other environmental criteria in the technical specifications of tenders and provides tools to facilitate their implementation (EC n.d.-b). A monitoring system is in place.</p> <p>In 2015, the first year of implementation of the GPP NAP, 29 of all contracts conducted included some GPP criteria; this represents 0.2% of all contacts published in the reporting period (UNEP 2017b).</p> <p>Implementation of the GPP NAP is ensured by the Department of Environment through an annual review of achievements. The Department of Environment communicates regularly through electronic newsletters to all contracting authorities and stakeholders in order to update them on ongoing GPP developments at the European level and other GPP-related topics. Capacity-building activities are carried out by the Public Procurement Directorate and the ministry—for example, training on GPP and e-procurement (EC n.d.-b).</p> <p>Estimated by value, GPP uptake was less than 20% in 2009–10; estimated by number, it was between 20% and 40% in 2009–10 (EU 2012).^a</p> <p>A particular issue faced by the country’s contracting authorities is the small size of the internal market, which limits the variety of green products available. To address this issue, the Department of Environment carries out market research to identify green products on the Cyprus market to be promoted within public procurement, resulting in green products and eco-labeled catalogs for</p>	<p>There is evidence of an implementation gap, but its size is unclear. GPP uptake was rather low in 2009–10, and Cyprus is facing the specific challenge of a small internal market. However, Cyprus is actively addressing this issue and also makes efforts in training, capacity building, and others. Cyprus is also very active in various GPP projects and is making a big effort in GPP implementation. The 50% target set by the EU was not met in 2009–10.</p> <p>→ GPP gap country</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Czech Republic	<p>SPP provisions, including green provisions, exist in overarching or thematic national policies and in procurement regulation (UNEP 2017b). The Czech Republic was the first Eastern European country to develop a NAP on GPP in the early 2000s. The Czech procurement system is being used to promote environmental policy goals in line with the Europe 2020 Strategy. In 2010 official GPP rules regulating procurement procedures at the central government level were adopted (EC n.d.-b).</p>	<p>contracting authorities. Since 2014 it also gives GPP awards to contracting authorities that were most successful in implementing environmental criteria (EC n.d.-b). Cyprus is also involved in various international projects.^b</p> <p>GPP rules state that 25% of all state and public vehicles need to respect environmental standards. The Ministry of Environment monitors the application of GPP rules and publishes data in its annual report. The GPP rules stipulate criteria for the purchasing of certain products. Contracting authorities need to consider eco-labels, environmental standards and certifications, energy performance certificates, and labels guaranteeing a renewable source of energy in their procurement decision. Eco-efficiency throughout the product life cycle needs to be taken into account. However, formally, the “rules” only express a political will, not a binding commitment (EC n.d.-b). Estimated by value, the Czech Republic applied GPP criteria in 20% to 40% of cases in 2009–10. Estimated by number, GPP uptake was less than 20% (EU 2012).</p>	<p>There is evidence of an implementation gap. Policies exist, but in 2009–10, GPP uptake was still low, and commitment is not binding. The 50% target set by the EU has not been met.</p> <p>→ GPP gap country</p>
Denmark	<p>Denmark has SPP policies in place, including GPP measures; however, the GPP strategy does not set specific targets and is mostly voluntary. It covers all national, state, regional, and local public authorities (UNEP 2017b).</p>	<p>The Ministry of Environment has several initiatives to promote GPP: (a) a national knowledge-sharing forum where procurers from both public and private organizations can access updated best practices, methods, and tools for GPP; (b) a GPP partnership with several municipalities based on joint, mandatory procurement objectives; (c) a website where procurers can find green criteria ready to insert into tender documents for numerous product areas as well as total</p>	<p>Denmark is among the top GPP performers. The 50% target set by the EU has been met. Various tools exist to promote GPP.</p> <p>→ Advanced GPP country</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Estonia	<p>Estonia does not have a GPP NAP yet (EC 2020a). Estonia's National Reform Program declares the government's intention to use the procurement process to advance secondary policy goals under the Europe 2020 Strategy, but specific goals and means have not been developed. It set the goal of 10% GPP uptake by 2014.</p>	<p>cost of ownership (TCO) tools for select product areas; and (d) a national task force to assist public authorities to implement GPP, consisting of a team of consultants who help public organizations to implement GPP (Ministry of Environment, Denmark n.d.). There is monitoring on SPP and GPP policies, but it is not systematic (UNEP 2017b).</p> <p>Despite the absence of a central e-procurement strategy, Denmark has long been considered a leader in developing e-procurement capabilities, having established electronic tendering as far back as the late 1990s (EC n.d.-b). In 2006 Denmark was among the top performers with regard to the uptake of GPP (Bouwer et al. 2006). In 2013, 71% of the monitored tenders included at least one green requirement (UNEP 2017b). Case studies point to a reduction in carbon dioxide (CO₂) emissions due to GPP (UNEP 2017b). Denmark was part of the Baltic GPP Project, a GPP capacity-building project for the Baltic Sea region (Keep.eu 2015).</p> <p>Training workshops are organized to promote the implementation of GPP into tenders in accordance with the Europe 2020 agenda. Estonia ranks among the most advanced EU member states in terms of e-procurement. E-notification has been mandatory since 2001, and compliance is effectively 100% for contracts above €10,000 for goods and services and €30,000 for public works. The rapid development of e-procurement relies on both comprehensive e-procurement services and wide dissemination of e-procurement practices among contracting authorities and economic operators through awareness-</p>	<p>There is evidence of an implementation gap. Secondary policy goals with regard to GPP exist, but there is still no GPP NAP; targets are modest.</p> <p>→ GPP gap country</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Finland	<p>The 2007 Act on Public Contracts states that contracting authorities must try to organize their procurement procedures as economically and as systematically as possible, in combinations that are as appropriate as possible, while taking environmental considerations into account (Hasanbeigi, Becqué, and Springer 2019). Since 2009, dedicated SPP policies have been in place, and today there is a national GPP network consisting of more than 30 public procurement entities (UNEP 2017b).</p>	<p>raising actions, guidelines, and trainings. Estonia's highly developed e-procurement environment and e-procurement portal are frequently referred to as best-practice examples for other member states because they are rapid and easy to use (EC 2020a). Level of GPP uptake was below 20% in 2009–10 in terms of both value and number (EU 2012).</p> <p>In 2006 Finland was among the top performers with regard to the uptake of GPP; the country had more tenders with green criteria than the other 18 countries analyzed (Bouwer et al. 2006). In 2009–10 GPP uptake by number was less than 20%. However, GPP uptake by value was above 80% (EU 2012). According to results from the monitoring of SPP in 2009 and 2012, around 50% of the tender calls included some kind of environmental criteria, and around 30% included well-specified environmental criteria (UNEP 2017b). A survey conducted in 2018 showed that less than half of all companies incorporate environmental aspects in their procurement policies. Finland was part of the Baltic GPP Project, a GPP capacity-building project for the Baltic Sea region (Keep.eu 2015). There is a Competence Center for Sustainable and Innovative PP, and Finland has a comprehensive set of policy measures (KEINO 2020).</p>	<p>Monitoring results from 2009 indicate that uptake by number is low, but uptake by value is high, which means that “the big fish” implement green criteria, but the “little fish” do not. More needs to be done to involve organizations with low-value contracts.</p> <p>A number of tools and measures exist to promote GPP, and the GPP competence center is highly recognized.</p> <p>→ Advanced GPP country</p>
France	<p>France has had dedicated SPP policies in place since 2007. The objectives set by the State Procurement Directorate for 2020 for all state buyers and agencies are that 30% (in number) of purchases above</p>	<p>In 2013, 6.7% of tenders (above €90, 000) included environmental criteria (UNEP 2017a). Easy-to-use “environmental product declaration” tools are available to promote the use of LCC (UNEP 2017b).</p>	<p>There is evidence of an implementation gap. The internal target is 30% of tenders to include environmental aspects, but in 2013 only 6.7% did. The</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	€90,000 include environmental clauses. There is a NAP for SPP (UNEP 2017b).		50% target set by the EU has not been met. → GPP gap country
Germany	Dedicated SPP policies have been in place since 2007 (UNEP 2017b). The German Procurement Regulation states that all public tenders must provide government procurers with an LCC analysis. State and federal laws propose consideration of ecological factors in procurement, and Germany adopted the world's first eco-label in 1978. The German government initiated a climate action program in 2014, which contains more than 100 measures to be implemented by 2020 with the aim of reducing greenhouse gas emissions by at least 40% compared to 1990 levels (Hasanbeigi, Becqué, and Springer 2019). Germany has a central platform to promote GPP and a web portal providing information on SPP. ^c	In 2006 Germany was among the top performers with regard to the uptake of GPP (Bouwer et al. 2006). Germany did not have a GPP monitoring process in 2019, but one was under development that will include a survey of procurement agencies and other related stakeholders. The monitoring will be done by federal authorities, with annual reports (Hasanbeigi, Becqué, and Springer 2019). In 2019 Germany had nearly reached its 40% emissions reduction target for 2020 (www.umweltbundesamt.de). Germany was part of the Baltic GPP Project, a GPP capacity-building project for the Baltic Sea region (Keep.eu 2015).	There is no or a small implementation gap. Germany is among the top performers in GPP. EU's 50% target seems to have been met: GPP uptake by number and value is between 40% and 60%. In 2019 Germany had nearly reached its emissions reductions target for 2020 (although it is unclear at this stage whether it was met in 2020). → Advanced GPP country
Greece	No GPP NAP exists yet (EC 2020a), but one is being developed. Environmental aspects have been included in Greece's presidential decrees (EC n.d.-b).	Less than 20% of contracts are compliant with the green procurement criteria. The public authorities have become more strict, especially regarding the energy performance of public and private procurement contracts for buildings and green electricity (EC n.d.-b).	There is no implementation gap, as there is no legal framework or NAP as yet. → Basic GPP country
Hungary	SPP provisions, including environmental criteria, exist in overarching or thematic national policies and in procurement regulations. There is no dedicated SPP policy, but the government has implemented some activities, for example, the national public procurement bulletin indicates whether a contract includes	Contracts including green criteria increased between 2012 and 2015 (both by value and by number). However, they declined slightly between 2014 and 2015 (UNEP 2017b).	Environmental criteria exist in overarching policies, but there is no dedicated GPP policy. Between 2014 and 2015, there was a downward trend in green contracts. → GPP gap country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Ireland	<p>environmental clauses (UNEP 2017b). There is no GPP NAP yet (EC 2020a).</p> <p>SPP provisions, including green criteria, exist in overarching or thematic national policies and in procurement regulations; a dedicated SPP policy includes green criteria. The target, which covers all national, state, regional, and local authorities, is for 50% of tenders in prioritized product categories to include SPP provisions. Enforcement is mandatory (UNEP 2017b).</p>	<p>The Department of Environment, the National Procurement Service, and other key stakeholders have formed an SPP Action Plan Implementation Group whose role is to monitor implementation of the SSP plan and to report on a yearly basis. A monitoring system is in place (UNEP 2017a). Guidance on GPP exists for the public sector (EPA, Ireland 2014). The level of GPP uptake was less than 20% in 2009–10. Ireland’s target under the Kyoto Protocol is to limit emissions to 13% above the 1990 baseline by 2012. The use of LCC or TOC^d calculations is widespread; however, only 25% of respondents reported that they mostly use this evaluation criterion (EU 2012). The use of e-procurement in Ireland is relatively well developed, having been implemented early; a range of services are offered to contracting authorities and bidders (EC n.d.-b).</p>	<p>Policies are in place, and there is an action plan and a monitoring system. By international comparison, however, GPP uptake is low. Emissions intensity is higher than in other European countries,^e and the reduction target has not been met.^f</p> <p>→ GPP gap country</p>
Israel	<p>SPP provisions exist in overarching or thematic national policies (National Green Growth Plan 2012–20), but no SPP provisions are included in existing procurement regulations. All government ministries must ensure that out of the total annual expenditure on procurement, green procurement reaches the following shares: 5% by 2013, 12% by 2016, and 20% by 2020 (UNEP 2017b).</p>	<p>SPP is mandatory only for ministries, which are required to submit GPP reports that are later made available to the general public. The Governmental Procurement Administration and the Ministry of Environmental Protection develop tenders including green criteria to help other ministries to purchase more sustainable products and services. There are green standards for building renovation and leasing, and purchasing activities are conducted by the public administration apparatus. There are green procurement</p>	<p>Only a few ministries provide full information on GPP. No aggregated indicators on GPP level are available, as the monitoring methodology is inconsistent. Among those that provide information on GPP, many ministries have been able to achieve their SPP, but not their GPP, goals. Ministries state that they require more help in developing their green procurement practices (UNEP 2017b).</p> <p>→ GPP gap country</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Italy	Dedicated SPP policies are in place. A GPP NAP was issued in 2008 and revised in 2013 (UNEP 2017b). According to the Law on Provisions on Environmental Measures to Promote a Green Economy and for the Containment of Excessive Use of Natural Resources, GPP must be included in all tenders related to energy (for example, energy services, office information technology equipment, street lighting, buildings) and in 50% of tenders in other product categories (UNEP 2017b). Italy is one of the few countries that has made GPP mandatory at all levels of government (UNEP 2019).	requirements for new government vehicles (UNEP 2017b). The NAP aims to encourage GPP through the involvement of stakeholders at the national level, training and information campaigns, methodological guidance on setting up sustainable procurement processes and environmental criteria, periodic monitoring of dissemination of the GPP, and analysis of the environmental benefits obtained; national targets are to be attained and redefined every three years (UNEP 2017b). Based on contracts signed in 2009–10, Italy applied green procurement criteria in 20% to 40% of cases (Hasanbeigi, Becqué, and Springer 2019); GPP uptake was between 40% and 60% in 2009–10 (EU 2012). More than 50% of companies gave a positive answer to the question, “Are any environmental criteria taken into account in your organization when purchasing?” (Bouwer et al. 2006).	The evidence of an implementation gap is mixed: the 50% target set by the EU seems to have been met, but evidence differs between sources. Many efforts are being undertaken at the national level. Monitoring results on SPP are not publicly available (UNEP 2017b). → Mixed-evidence country; probably a GPP gap country
Latvia	Environmental criteria can be introduced in tender procedures as a part of technical specifications or selection criteria. However, the use of green public procurement is not mandatory for contracting authorities, and their use is limited. Latvia established requirements for the development of green public procurement along with a wider supply of energy-efficient and ecological goods in the National Development Plan for 2014–20. It also adopted a GPP Promotion Plan 2015–17, a short-term strategic policy that aims to promote sustainable purchasing and production and to	Latvia’s objectives will be implemented through the use of the EU Structural Funds and the Cohesion Fund. The measures foreseen to achieve its goals are the development of the regulatory framework of GPP, the production of guidelines and standardized documentation for the purchase of certain products and services, the promotion of green products, the development of an LCC estimation model for certain product groups, the organization of training courses and awareness-raising campaigns for contracting authorities at the state and local levels, as well as annual monitoring and reporting on GPP by the Ministry of Environment and Regional Development (EC n.d.-b). According to the	Green criteria and implementation measures are still being developed. GPP uptake is low, and targets have not been met. → GPP gap country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	increase GPP up to 30% by 2017 (EC n.d.-b).	Procurement Monitoring Bureau, only 4.5% of contracts awarded between 2010 and 2013 included environmental criteria (EC n.d.-b). In 2009–10 GPP uptake was below 20% in terms of number and 20%–40% in terms of value (EU 2012).	
Lithuania	Lithuania’s procurement strategy focuses on GPP, with several successive GPP plans set up by the Ministry of Environment. The GPP implementation measures for 2012–15 aim to strengthen the capacity of contracting authorities to carry out GPP, to encourage suppliers to put more environmentally friendly products on the market, and to collect and disseminate information on these kinds of products. Specific mandatory environmental criteria are defined for 4 product groups covering a wide range of purchases (EC n.d.-b).	Training courses on GPP and e-procurement are being organized. In 2014 around 6% of public contracts included environmental criteria (15% in value) primarily public works, office and computing equipment, as well as firefighting, police, and defense equipment contracts. Monitoring of GPP is centralized by the Public Procurement Office and is based on direct reporting from contracting authorities, who are required to submit a report on their use of GPP and environmental criteria (EC n.d.-b)	NAPs are in place, but GPP uptake is still low. → GPP gap country
Luxembourg	There is no GPP NAP yet (EC 2020b), but a NAP for SPP includes green criteria. No targets have been defined, and few concrete measures have been implemented to ensure the adoption of environmental and social criteria in tender procedures (EC n.d.-b).	The government has taken a step toward integrating environmental criteria in tenders by agreeing to participate in the Resource Centre of Technologies and Innovation for Building, which is responsible for standardizing the clauses in procurement contracts, in particular, regarding sustainable building (EC n.d.-b). The level of GPP uptake is not available for Luxembourg due to no response (EU 2012).	No implementation gap exists, as no legal framework, NAP, or targets exist. → Basic GPP country
Malta	GPP has been included in Malta’s strategic framework since 2005. In 2012 the GPP NAP defined the overall strategy and a comprehensive set of measures to reach 50% uptake of GPP by 2015 (both in value and in number of tenders). The same target was adopted in the NAP for 2009,	The GPP Office is responsible for implementing and monitoring the 2012–15 NAP and works in close collaboration with the Department of Contracts. It provides contracting authorities with guidelines on 18 priority product groups and detailed environmental criteria to be integrated into	NAP and targets exist, but they have not been met so far. That said, Malta is making a big effort to increase GPP uptake. Implementing the GPP strategy is one of Malta’s top near-term priorities (EC n.d.-b).

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	<p>but was not achieved. Information is lacking at the local level, as are specific targets and monitoring. The Department of Contracts has required the creation of a GPP function within contracting authorities in order to implement the national strategy on green public procurement (EC n.d.-b).</p>	<p>tenders. The NAP states that all tenders falling under EU-funded programs must be prepared according to these guidelines, a goal that was achieved in 2013. Various trainings and information sessions are organized to raise awareness of GPP among contracting authorities and economic operators. All procurements issued by the Department of Contracts or other contracting authorities have to be scrutinized and cleared by the GPP office to ensure that they properly integrate sustainable development criteria.</p> <p>The Department of Contracts encourages contracting authorities to adopt GPP and e-procurement through the publication of circulars. For instance, it requires each contracting authority to create a GPP coordinator to ensure that published tenders comply with green public procurement criteria. The Malta Intelligent Energy Management Agency is reinforcing its human resources with expertise in green public procurement strategies and promoting eco-innovative products within procurement procedures.</p> <p>Although most of the tenders published include environmental criteria, few of them meet the EU green public procurement common criteria. In 2012 only 4.5% of tenders falling within 18 priority product and service groups identified in the GPP NAP were fully compliant with GPP criteria (EC n.d.-b).</p>	<p>→ GPP gap country</p>
<p>Netherlands, the</p>	<p>In 2005 the Netherlands introduced its first set of comprehensive GPP criteria and targets for the approximately 7,500 contracting authorities involved in public</p>	<p>In 2006 the Netherlands was among the top performers with regard to the uptake of GPP, with more tenders with green criteria than the</p>	<p>The Netherlands is a leader in the application of environmental criteria (Melissen and Reinders 2012). Tools, measures, and institutions exist to</p>

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	procurement (Hasanbeigi, Becqué, and Springer 2019). Dedicated SPP and GPP policies are in place and included in procurement regulations. The Netherlands has high ambitions regarding circular procurement, use of bio-based products, innovation, and climate change (UNEP 2017b).	<p>other 18 countries analyzed (Bouwer et al. 2006).</p> <p>The Netherlands is a frontrunner in GPP, having achieved, according to its own monitoring results, the government's ambitious 2005 target of 100% GPP by 2010 for central government procurement. Subsequently a 100% target was set for other public authorities to meet by 2015 (Hasanbeigi, Becqué, and Springer 2019). Buyer groups exist at the municipal level to negotiate joint green criteria for purchase projects and one-stop-shop centers to support the demand as well as the supply side of GPP (TN02; TN003). Tools, measures, and institutions exist to support implementation of GPP, such as the CO₂ performance ladder, DuboCalc, and PIANOo (Professional and Innovative Tendering Network for Government Contracting Authorities).</p>	<p>promote GPP. Uptake is high by international comparison.</p> <p>→ Advanced GPP country</p>
Norway	Dedicated SPP policies have been in place since 2007, and SPP policies exist in procurement regulation (UNEP 2017b). Norway follows the EU legal framework on public procurement and has produced various eco-labels and national guidelines (Igarashi, de Boer, and Michelsen 2015).	Environmental award criteria seem to have little influence on final decisions in supplier selection, as little weight is attached to these criteria in the selection process (Igarashi, de Boer, and Michelsen 2015). There are no SPP indicators and no monitoring of SPP (UNEP 2017b). Norway was part of the Baltic GPP Project, a GPP capacity-building project for the Baltic Sea region (Keep.eu 2015).	<p>Evidence points toward an implementation gap. "Overall, Norway has a strong foundation for sustainable public procurement, notably in the area of the legal and regulatory framework. Weaker points relate to the implementation and uptake of sustainable public procurement throughout Norway's entire public procurement system and to the accountability framework" (OECD n.d.-b).</p> <p>→ GPP gap country</p>
Poland	SPP provisions are in place in overarching or thematic national policies and in existing procurement regulations;	The Public Procurement Office provides GPP training events, organizes an annual conference on GPP, and has developed and	The EU target and a national target set for 2016 were not reached in 2015.

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	dedicated SPP policies are also in place. The Public Procurement Office promotes the application of EU GPP criteria (on a voluntary basis). The GPP goal to be attained by the end of 2016 is for 20% of the total number of awarded contracts to include environmental clauses (UNEP 2017b).	issued two guidebooks on GPP. In 2015 the inclusion of environmental aspects in contract award procedures by the Polish contracting authorities amounted to 11.4% (UNEP 2017b).	→ GPP gap country
Portugal	The Ministry of Environment and the Central Procurement Agency are in charge of GPP. A GPP plan is being supported by the National Laboratory of Energy and Geology in the form of a partnership. Its role is to support the capacity of and raise awareness among public procurers with regard to SPP, with the specific objective of achieving low-carbon procurement processes. Public authorities have gradually expanded the incorporation of environmental requirements into award criteria and technical specifications. These environmental aspects include, for example, energy efficiency and CO ₂ emissions levels, use of recycled content and reduced packaging, as well as waste management and fuel consumption (EC n.d.-b). There is a 2007 National Strategy for Green Public Procurement (da Silva Gomes 2013).	Level of uptake (by number and value) was less than 20% in 2009–10 (EU 2012). GPP as a share of total public procurement was 2% in 2012 (Hasanbeigi, Becqué, and Springer 2019). GPP monitoring results indicate that 56% of procedures included environmental criteria in 2010 (Hasanbeigi, Becqué, and Springer 2019). Monitoring of the execution of the 2007 National Strategy for Green Public Procurement has not been consistent, which has contributed to the lack of transparency and complicated the implementation of GPP (da Silva Gomes 2013).	The 50% target set by the EU was not met in 2009–10, but more than half of procedures included environmental criteria. GPP implementation is viewed as difficult. All sources are relatively old. In the meantime, there is evidence of efforts to implement GPP at the regional level (EC 2020a; Xpress 2020). → GPP gap country
Romania	A NAP is being developed that sets targets for the application of green criteria in the purchase of certain types of products. The National Environmental Protection Agency issues an annual monitoring report on the use of GPP. The report is based on information registered in the national e-procurement platform and the	The Ministry of the Environment organizes dissemination events and conferences on GPP as well as training programs for public procurers in central and local administration. Since 2006, contracting authorities have been obliged to conclude 40% of their annual public procurement contracts worth more than €30,000 through electronic methods, either	GPP development is in its infancy, a NAP is still being developed, and uptake by number is low. It is not clear whether targets have been reached. However, Romania is comparatively advanced in the use of e-procurement. → Basic GPP country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	self-reporting of contracting authorities (EC n.d.-d).	through end-to-end procurement procedures or through direct acquisitions via the e-catalog. Fully electronic procurement from notification to submission amounted to 6.2% of total procurement in 2011, putting Romania ahead of many EU member states (EC n.d.-d). In 2009–10 GPP uptake was below 20% by number and between 20% and 40% by value (EU 2012).	
Russian Federation	Since 2014, public procurement has been regulated by the Law of Contractual Relations, which includes some elements of sustainable procurement. The “contract life cycle” is used in accounting for the life cycle value of projects, and some GPP elements are required in procurement (Hasanbeigi, Becqué, and Springer 2019).	The Olympic Games in Sochi were the first large-budget project in Russia that was required to meet ecological standards in construction, food and catering, transport, and electricity, among others (Hasanbeigi, Becqué, and Springer 2019).	Since there are no clear targets and no policies directly targeting GPP, there is no implementation gap. → Basic GPP country
Slovakia	SPP provisions exist in overarching or thematic national policies and in procurement regulations. Dedicated SPP policies are in place, including a GPP NAP for 2011–15. The Ministry of the Environment has committed to integrating requirements for eco-labeled products in its procurement practices. The target was to include GPP provisions in 65% of the tenders of central government and in 50% of those of regional governments and cities by 2015. The GPP NAP is mandatory for central government and recommended for regional governments and cities (UNEP 2017b).	The Ministry of Environment coordinates activities under the GPP NAP, supports GPP training, coordinates annual GPP monitoring, and coordinates working groups on GPP. The Slovak Environment Agency organizes seminars for public authorities, provides help desk services, maintains a website on GPP, and conducts other communication activities. In 2015 about 66% of works contracts, 18% of products contracts, and 20% of services contracts (in terms of number) were green. In the same year, about 97% of works contracts, 3% of products contracts, and 10% of services contracts by value were green (UNEP 2017b).	Uptake of GPP is low for three reasons (Van der Zwan 2018): (1) The government does not prioritize environmental concerns, and thus commitment to GPP implementation is low. (2) The regulatory framework is complicated, and it is not clear what is expected from stakeholders, which discourages suppliers from participating in GPP tenders. (3) Lack of experience and knowledge prevent procurers from applying GPP. → GPP gap country
Slovenia	A short-lived Public Procurement Agency was set up in 2011 to carry out joint procurement on behalf of the central government, develop e-procurement tools,	In 2009–10 GPP uptake was below 20% in terms of number and 20%–40% in terms of value (EU 2012). Procurement trainings, including GPP, are being conducted. In 2013	The 50% target has not been reached; the number of GPP requirements applied in contracts is low.

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	and foster awareness and adoption of GPP. It was dismantled in 2012 as part of a reorganization effort, and its functions were devolved back to the respective ministries. Some policies for green and social public procurement have been introduced. A GPP NAP adopted in 2009 set a target for 50% of awarded contracts for 8 product categories to incorporate GPP by 2012 (EC 2020a).	contracting authorities applied GPP requirements for 11.7% of contracts by number and 8% by value (EC 2020a).	→ GPP gap country
Spain	SPP policies are in place, and SPP provisions exist in procurement regulations; the GPP Plan of the National Administration has been in place since 2008, setting quantitative and qualitative targets for different years for different categories of products, services, and works considered a priority for GPP by the European Commission. Participation is voluntary (UNEP 2017b). Spain participated in EU funding of the GPP 2020 Project from 2013 to 2016. GPP 2020 aimed to increase the number of tenders that take carbon emissions into account and to mainstream low-carbon procurement in Europe, in support of the EU's goal of a 20% reduction in greenhouse gas emissions by 2020 (Hasanbeigi, Becqué, and Springer 2019).	GPP uptake (by number and value) was between 40% and 60% in 2009–10 (EU 2012). According to the monitoring results of the GPP Plan of the National Administration, the target level of compliance was met, and positive results were achieved in many of the categories of products and services prioritized in the plan. The monitoring report concludes, “Significant progress was made in the main groups of products and services that are included in the GPP Plan” (UNEP 2017b).	Spain has met many (but not all) of its own targets and has either met or come close to meeting the 50% target set by the EU. Yet development of SPP is slow as a result of lack of training and supply-side issues, among others (Jimenez, López, and Escobar 2019). Although environmental criteria are being progressively introduced, their presence is tentative (average weight of 6.02%); the economic aspect is still the most decisive one (73.14%), followed by the technical (18.67%) (Braulio-Gonzalo and Bovea 2020). → GPP gap country
Sweden	In 2007 the government launched a NAP for GPP; many activities are still ongoing even though the plan is officially closed. In 2016 the Swedish government launched a new national strategy for public procurement that relates to all aspects of sustainability (including environmental aspects). Public authorities at the national	In 2006 Sweden was among the top performers with regard to the uptake of GPP. More than 60% of tenders included some green criteria, and more than 90% of organizations stated that they take environmental criteria into account when purchasing (Bouwer et al. 2006). In 2009–10 GPP uptake was 60%–80% by number and	GPP uptake is comparatively high internationally. Sweden has a high-performing public procurement system, which is fairly advanced in its strategic dimension, including green, innovation, and social criteria (EC n.d.-c). → Advanced GPP country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	level are required to have environmental management systems in place, to consider sustainability aspects in their procurement activities, and to report on how often sustainability criteria are used in their procurement processes and whether their framework agreements include sustainability criteria (UNEP 2017b).	40%–60% by value (EU 2012). Environmental criteria were used in 60% of the total volume of public procurement in 2015, 67% in 2014, and 53% in 2013 (UNEP 2017b).	
Switzerland	SPP provisions exist in overarching or thematic national policies and in procurement regulations. No quantitative targets have been set. The Sustainable Development Strategy 2016–19 defines vague goals for SPP—for example, “In its public procurement of goods, services, and construction services, the Confederation endeavors to ensure that they satisfy high economic, environmental, and social requirements throughout their life cycles. It sets an example with its own procurement activities, by purchasing products and constructing buildings that are economical, environmentally compatible, and healthy and are produced or built by means that are as socially responsible as possible” (UNEP 2017b).	The integration of sustainability-related criteria in procurement processes has to be indicated for certain product categories before the tender is published on the e-procurement platform SIMAP. General guidelines on how to implement SPP have been produced. Even though no priority products and service categories have been formally identified, SPP criteria have been defined for some of them. A course on sustainability has been designed for procurers (UNEP 2017b).	Certain goals have been defined, but no quantitative targets have been set. No information is available on GPP uptake. A research project is being undertaken to determine the status quo of Swiss procurement regarding sustainability criteria. ^f → GPP gap country
United Kingdom	In 2005 the UK government stated the ambitious goal of becoming one of the EU’s leaders in sustainable procurement by 2009. In 2010 the UK Department for Environment, Food, and Rural Affairs published the Action Plan for Driving Sustainable Operations and Procurement across Government, in support of the policy goals. Following the NAP of 2006, all central government departments and	The Cabinet Office monitors compliance with the “greening government” commitments by regular surveys that all relevant organizations must complete. An environmental assessment method that is appropriate to the size, nature, and impact of a project must be carried out on all projects, using appropriate government guidance (Hasanbeigi, Becqué, and Springer 2019).	Evidence is mixed. Numbers from 2009–12 suggest that the United Kingdom has not met its ambitious goals. However, GPP uptake is comparatively high internationally. In 2020 the government published a Green Paper to reform public procurement “to speed up and simplify our procurement processes, place value for money at their heart, and unleash opportunities for small

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	related organizations must ensure that they meet the mandatory levels of the government buying standards. The Public Procurement Policy and Government Buying Standards and the National Procurement Strategy for Local Government in England were designed to support GPP at both national and local levels. Goals set by the UK government were, for example, to reduce the carbon footprint of government activities, to support a lower-carbon public sector, and to encourage voluntary initiatives to reduce the carbon footprint of key government suppliers (Hasanbeigi, Becqué, and Springer 2019).	In 2006 the United Kingdom was among the top performers with regard to the uptake of GPP; more than 80% of organizations stated that they take environmental criteria into account when purchasing and almost 60% of public tenders included green criteria (Bouwer et al. 2006). By number of transactions, GPP uptake was between 40% and 60% in 2009–10; by value, it was less than 20% (EU 2012).	businesses, charities, and social enterprises to innovate in public service delivery,” where “value for money does not ... mean simply selecting the lowest price ... but involves economic, social, and environmental value over its life cycle” (Parliamentary Secretary 2020). → Mixed-evidence country

a. GPP uptake by number is defined as the % of individual contracts that included all core green criteria set at the EU level, while GPP uptake by value is defined as the % of the all contracts, by value, that included all core green criteria in the EU27 in 2009–10 (EU 2012). Differences in percentages between the indicators can be explained by the fact that, within indicator 1, a high-value contract is of greater weight than a low-value contract (Pricewaterhouse Coopers, Significant, and Ecofys 2009).

b. For more information, see https://ec.europa.eu/environment/gpp/pdf/copenhagen_12-13_june_2018/180611_Update_GPP_Member_States.pdf.

c. For the Central Portal for Sustainable Procurement of Public Clients (Beschaffung des BMI), see http://www.nachhaltige-beschaffung.info/DE/Home/home_node.html. For the Sustainability Compass, see <https://www.kompass-nachhaltigkeit.de/en/>.

d. See <https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/co2/>.

e. See <http://www.epa.ie/ghg/currentsituation/> and <http://www.epa.ie/ghg/indicatorsprogressstotargets/>.

f. For more information, see <http://p3.snf.ch/project-172351>.

Table C.4: Green public procurement (GPP) uptake in the Americas

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
Antigua and Barbuda	No dedicated sustainable public procurement (SPP) policies are in place, but several laws have an impact on SPP. Nevertheless, while these laws are on the books, regulations are needed for their implementation (UNEP 2017b).	No information on GPP uptake is available in any of the four sources used in this analysis.	No implementation gap exists, as regulations for implementation have not been developed yet. → Basic GPP country
Argentina	SPP policies that include environmental concerns have been in place since 2012 (UNEP 2017b).	Piecemeal evidence exists on GPP uptake—for example, there was a high degree of efficiency in air conditioning units contracted in 2014. A monitoring system is in place (UNEP 2017b).	SPP policies, including green measures, are in place, but there is little evidence on implementation or uptake. → GPP gap country
Brazil	SPP policies have been in place since 2010 that include measures for air pollution. No goals or specific targets have been expressed in the national legislation (UNEP 2017b).	No monitoring system is in place to measure the uptake of SPP or GPP, but some information is available from the Catálogo de Materiais (CATMAT): of 149,119 purchasing processes, 1,047 (7%) were sustainable (UNEP 2017b).	Policies are in place, but no goals have been set or specific targets expressed in the national legislation, and results are not measured systematically. → GPP gap country
Canada	Dedicated SPP policies have been in place since 1996. The GPP policy does not set any targets or goals. It is mandatory but covers only national government public authorities (UNEP 2017b).	Monitoring from 2012 shows that significant progress had been made in implementing the GPP policy. Fundamental policy mechanisms are in place, including a governance structure, an implementation plan, guidance and tools, and free online training for government employees. In 2014–15, 99% of managers and functional heads of procurement ran performance evaluations that included support and contribution toward green procurement, and 89% of specialists in procurement or material management completed the Canada School of Public Service’s GPP course or an equivalent. The government has encountered several obstacles in implementing GPP (UNEP 2017b). (1) Procurement personnel have to balance	The government faces several challenges with regard to GPP uptake, although significant progress has been made. → GPP gap country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
		many different objectives. (2) It is difficult to measure actual green purchases. (3) It is difficult to obtain a detailed, comprehensive picture of green procurement at the government level. (4) It is challenging to attribute reductions in environmental impacts directly to procurement activities. (5) While the federal government is a major buyer, its purchasing power alone is too small to enable the market to offer greener products at lower prices. (6) Much of the lower-risk procurement activity is decentralized.	
Chile	No dedicated SPP policies are in place, but in 2012 the national public procurement agency (ChileCompra) approved the Social Responsibility in Public Procurement Policy, which highlights the role of public procurement in balancing environmental and socioeconomic aspects (UNEP 2017b).	The implementation of ChileCompra's SPP policy and related guidelines is voluntary for purchasing agencies. Nevertheless, the Procurement Law and the Supreme Decree regulating the law establish some mandatory rules related to socioeconomic sustainability. Monitoring is in place, but no public authority is subject to formal monitoring, and results are not published (UNEP 2017b). In 2014 almost 40% of purchasing orders contained some sustainability criteria (UNEP 2017b). Chile has implemented a thorough monitoring system through its e-procurement platform ChileCompra Express (UNEP 2019).	No implementation gap exists, as no dedicated policies are in place for GPP. → Basic GPP country
Colombia	No dedicated SPP policies are in place, but the Ministry of the Environment and Sustainable Development is formulating an SPP National Action Plan (NAP) together with the National Procurement Agency. Enforcement is voluntary (UNEP 2017b).	In 2013 a survey to evaluate the level of SPP was submitted to central government agencies that had participated in training sessions. Almost 13% of the procurement budget was found to include environmental or social criteria (UNEP 2017a).	No implementation gap exists, as no dedicated policies are in place for GPP. → Basic GPP country
Dominican Republic	SPP provisions exist in overarching or thematic national policies and in	No information is available on GPP implementation or uptake.	No implementation gap exists, as no GPP policies are in place.

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
	procurement regulations; however, no dedicated SPP policies are in place (UNEP 2017b).		→ Basic GPP country
Mexico	SPP provisions exist in overarching or thematic national policies and in existing procurement regulations; dedicated SPP and GPP policies are in place (UNEP 2017b). However, air pollution and climate change are not a priority in sustainability goals (UNEP 2017b). Mexico has no overall policy on GPP, but efforts have been made in specific sectors (Hasanbeigi, Becqué, and Springer 2019).	Procurement regulations contain some provisions relevant to GPP. Since 2013, GPP policy has been part of the National Strategy on Sustainable Production and Consumption and the Special Sustainable Consumption and Production Program 2014–2018, which both identify promotion of GPP as their first objective. The Ministry of the Environment and Natural Resources is working to implement GPP guidelines developed by the Inter-American Network on Government Procurement (Hasanbeigi, Becqué, and Springer 2019). No evidence was found on uptake of GPP.	Policies are in place, but no evidence on GPP uptake was found. Evidence is unclear. → Mixed-evidence country
Paraguay	SPP provisions exist in procurement regulations, and dedicated SPP policies are in place. However, emissions and climate change mitigation are not a focus (UNEP 2017b).	No information was found on GPP implementation and uptake.	There is no implementation gap, as GPP is not yet a focus or a part of SPP. → Basic GPP country
Peru	SPP provisions exist in procurement regulations; no dedicated SPP policies are in place, and there are no SPP provisions in overarching or thematic national policies (UNEP 2017b).	No information was found on GPP implementation and uptake.	There is no implementation gap, as there are no GPP policies yet. → Basic GPP country
Uruguay	SPP provisions exist in overarching or thematic national policies and in procurement regulations; however, no dedicated SPP policies are in place. The Strategic SPP Plan for 2015–20 sets the objective to include the life cycle perspective in public procurement (UNEP 2017b).	No information was found on GPP implementation and uptake.	GPP seems at a nascent stage, but information is scarce. → Mixed-evidence country

Country	GPP policies and targets	Implementation measures	Conclusion regarding implementation gap
United States	SPP provisions exist in overarching or thematic national policies and in procurement regulations; dedicated SPP policies are in place. There are various targets with regard to GPP, for example, national, government-wide, and agency-specific targets exist for reductions in greenhouse gas emissions and disclosure of carbon footprint; new federal buildings have to meet green standards and achieve zero-net energy by 2030 (UNEP 2017b). Targets have been set with regard to GPP: by 2020 the federal government will reduce scope 1 and 2 greenhouse gas emissions by 28% compared to a 2008 baseline; by 2020, the federal government will reduce scope 3 greenhouse gas emissions by 13% compared to a 2008 baseline (Hasanbeigi, Becqué, and Springer 2019).	The 28% emissions reduction target was not met in 2019. ^a There is monitoring of “whether individual agencies are staying on track toward achieving the overarching government-wide goals and how much progress agencies are making to achieve the activities and milestones identified in their annual plans or as prescribed ... Agencies are asked to conduct quarterly reviews of at least 5% of the acquisitions awarded in that period and report on compliance with the sustainable acquisition goals. If agencies fall below the 95% compliance rate, they are supposed to identify corrective actions that they will take during the following six-month period to address the barriers or underlying conditions for noncompliance” (OECD 2015).	Systematic reviews are in place to ensure that companies comply with sustainability goals and take corrective measures if they do not. However, “because there are hundreds of thousands of buying points across multiple agencies, without one unified law or purchasing system, it is very difficult for US federal government agencies to obtain accurate information and track which green products they purchase” (OECD 2015). The emissions reductions target for 2020 was not met in 2019. → GPP gap country

a. Calculations based on <https://www.statista.com/statistics/183943/us-carbon-dioxide-emissions-from-1999/>.