Monitoring Progress in Green Public Procurement

Methods, challenges, and case studies

IISD REPORT

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Executive Summary

This report outlines the importance of monitoring green public procurement (GPP) and highlights various methodologies, challenges, and recommendations for improving monitoring practices. The report focuses specifically on improving the monitoring of the impact of GPP on greenhouse gas and carbon dioxide emission reductions.

Effective GPP monitoring is key for countries to track progress toward their climate goals. An analysis of GPP practices in countries like South Korea, Japan, Slovenia, Denmark, Malaysia, and the Netherlands reveals that successful GPP monitoring is driven by strong government support, effective collaboration, and access to necessary tools and resources. Challenges such as data insufficiency and the complexity of GPP monitoring tools are common hurdles.

To address these challenges, we propose several recommendations:

- defining clear, measurable objectives for GPP;
- establishing a comprehensive legal and policy framework that mandates monitoring;
- fostering effective collaboration across governmental bodies;
- strengthening data management and control systems;
- investing in training and capacity building for procurement personnel; and
- enhancing communication among stakeholders to share best practices and support lagging sectors and/or contracting authorities.

These recommendations allow governments to step up their efforts to monitor GPP and GPP impacts. The results of this monitoring will provide governments with the necessary evidence to keep increasing GPP efforts and ensuring the use of public procurement as a driver of climate and sustainable development goals.

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Abbreviations and Acronyms

CFL	compact fluorescent lamps
CO_2e	carbon dioxide equivalent
CO_2PL	CO_2 Performance Ladder
EIO	Economic Input-Output
EMS	environmental management system
EPD	Environmental Product Declaration
EU	European Union
GHG	greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GPP	green public procurement
ICT	information and communication technology
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
KEITI	Korea Environmental Industry and Technology Institute
LCA	life-cycle assessment
$LCC\text{-}CO_2$	life-cycle costing and CO_2 assessment tool
LED	light-emitting diode
MGTC	Malaysian Green Technology and Climate Change Corporation
MoE	Ministry of Environment
OECD	Organisation for Economic Co-operation and Development
SPP	sustainable public procurement
UNEP	United Nations Environment Programme
WEF	World Economic Forum

1.0 Introduction

Public procurement is an important economic policy instrument that supports the implementation of countries' development objectives. In the European Union (EU) in 2021, government expenditures on goods, services, and works represented about 15% of the GDP, whereas in developing countries, public procurement makes up nearly 30% of the total GDP (Organisation for Economic Co-operation and Development [OECD], 2022). This enormous scale and spending power positions it as an important lever for advancing sustainable development and climate action.

The urgency of the climate crisis is evident (Intergovernmental Panel on Climate Change [IPCC], 2023). Human-induced climate change is affecting a multitude of weather and climate extremes across the globe, which has caused widespread adverse impacts and associated losses and damages to the environment and human society. These losses are related to biodiversity, economic losses, health issues, and many others. To mitigate these impacts, it is critical to maintain the global average temperature increase to within 1.5°C, which requires a reduction of carbon dioxide equivalent (CO_2e) emissions by 45% by 2030 (World Economic Forum [WEF], 2022). Many countries have responded with binding goals to achieve net-zero greenhouse gas (GHG) emissions. Net-zero emissions require a balance between the amount of GHGs emitted into the atmosphere and the amount removed from it. Achieving this balance will require drastic transformations in the way countries produce and consume goods, services, and infrastructure. As large consumers through public procurement processes, governments play a crucial role in this transformation (WEF, 2022).

Public procurement contributes approximately 15% to worldwide GHG emissions (WEF, 2022). "Greening" public procurement is therefore a critical strategy to support the reduction of GHG emissions related to government activities. The European Commission (2008) defines green public procurement (GPP) as "a process by which 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." GPP is a subset of sustainable public procurement (SPP), which the European Commission (2008) defines as "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." In this report, SPP and GPP are used interchangeably due to variations in priorities and terminology across different countries. Some countries pursue broad objectives, including social, environmental, and economic goals, calling it SPP, whereas others concentrate on minimizing environmental impacts, preferring the term GPP.

In recent years, the use of GPP has increased significantly. Nearly all OECD countries have formulated strategies or policies aimed at facilitating the integration of environmental goals into the public procurement process (Bryngemark et al., 2023). The IPCC (2022) also mentions GPP as one of the strategies to reduce GHG emissions, particularly in the industrial sector.

As more countries adopt GPP, it is important to develop robust monitoring and evaluation systems. Monitoring represents a crucial process for tracking progress in the implementation of GPP. At the policy level, monitoring results enhance transparency and demonstrate political commitment, which in turn encourages and legitimizes the promotion of GPP by others. Additionally, this process of monitoring and its results could aid communication with the market, offering more certainty to investors interested in sustainable production processes and products.

To advance GPP, countries have reformed legal and policy frameworks to enable or mandate GPP, improved the capacities of public procurers, and developed guidebooks, tools, and standard criteria for GPP. However, establishing GPP monitoring systems to track progress has often been an afterthought. Where monitoring systems exist, the focus is more on the process than on the actual results or impacts in terms of GHG emissions or environmental benefits. Without solid monitoring of these results or impacts, governments do not know whether they set the bar for GPP high enough, leading to risks of greenwashing or stifling innovation (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH [GIZ], 2022).

For example, if the success of GPP is only measured against an output, such as the number of tenders that include GPP criteria, procurement agencies may not be inclined to use procurement as a driver for innovation. Indeed, a procurement agency may, in this case, focus on increasing the number of GPP tenders, potentially without ensuring that the green criteria are challenging enough to drive significant environmental improvements. The ease of meeting these easily attainable standards might improve "administrative" output but does not necessarily drive the market toward greater sustainability (GIZ, 2022).

Focusing on both outputs and actual outcomes of GPP (in terms of environmental indicators) will reduce these risks. If agencies' GPP progress is measured by actual outcomes—for instance, CO_2 reduction or green market growth—the agency would be encouraged to allocate resources to initiatives that directly advance these goals and drive them to implement more impactful actions, such as establishing challenging criteria that are regularly updated to reflect developments in the market (GIZ, 2022). Furthermore, when this outcome is quantified, it can help to create political buy-in and provide evidence of public procurement's contribution to GHG reduction targets and the implementation of the European Green Deal (Nilsson Lewis et al., 2023). For example, if the outcome of GPP is calculated in the form of the total CO_2 emissions reduction, this quantified benefit acts as evidence of GPP's effectiveness in aligning with broader climate objectives. Armed with concrete data about the benefits of GPP, policy-makers are more likely to offer their support.

There is growing demand among authorities for quantified evidence of GPP's effectiveness in the reduction of GHG emissions (Bechauf et al., 2023). However, monitoring the quantified impact of procurement is rare in practice among EU member states (European Commission, 2021).

Section 2 of this paper discusses methods for monitoring GPP, with a special focus on monitoring GPP impacts in terms of GHG or CO_2 emissions. Section 3 elaborates on the challenges of monitoring GPP impacts, and Section 4 highlights best practice case studies.

Section 5 of the paper concludes with recommendations for improving and strengthening monitoring frameworks for GPP.

This paper is based on a desk review of existing literature, policy documents, and a review of current methodologies for monitoring GPP.

2.0 Monitoring Methods

GPP is a key instrument for promoting sustainable development and environmental protection. However, to be effective, GPP needs to be carefully monitored. This section discusses the different methods and approaches that can be used to monitor GPP. Section 2.1 discusses what to monitor, while Section 2.2 dives into more detail on how to monitor CO_2 or GHG impacts on public procurement.

2.1 What to Monitor

In monitoring GPP, public entities monitor and assess various aspects of their GPP programs based on their specific goals, priorities, tools, resources, and monitoring systems objectives (SWITCH-Asia, 2020). These aspects can be classified into three main elements: institutionalization, outputs, and outcomes (see Table 1) (GIZ, 2022; SWITCH-Asia, 2020). Monitoring and evaluating institutionalization and outputs helps the agencies responsible for GPP to track and ensure that GPP is implemented. Monitoring and evaluating outcomes helps policy-makers understand the real impact of GPP in terms of environmental benefits.

Table 1. Key indicators and data sources for monitoring GPP

Aspects to monitor	Indicators	Data sources
Institutionalization (process)	• Existence of GPP policy and legal framework • Establishment and assignment of leadership and coordination roles for GPP • Allocation of specialized staff for GPP support • Training on GPP • Existence of procurement procedures and tools that integrate GPP • Existence of monitoring and reporting systems	Surveys or questionnaires, interviews, direct review of existing plans or procedures
Output (procurement activities)	• Number or percentage of tenders that include green criteria • Number and total value of green products purchased • Number and total value of contracts with green criteria	E-procurement platforms, surveys, central procurement databases, tender publications and reports

Aspects to monitor	Indicators	Data sources
Outcomes (impacts)	Environmental benefits: • Reduction in GHG emissions and air pollution • Reduction in waste production • Water, energy, and toxic materials savings Economic benefits: • Cost savings (life-cycle perspective) • Externality cost savings	Surveys, reviews of product attributes, purchasing records of sustainable versus non-sustainable products, suppliers' reports

Source: Ecoinstitut, 2013; GIZ, 2022; SWITCH-Asia, 2020; United Nations Environment Programme (UNEP), 2016.

Monitoring institutionalization means monitoring how GPP is being integrated into an organization's culture and daily operations. To track the progress of institutionalization, some key indicators include the existence of GPP policies and legal frameworks, the assignment of leadership and coordination roles for GPP, the provision of specialized staff for GPP support, the existence of GPP-focused training, procurement procedures and tools that integrate GPP, and the presence of monitoring and reporting systems, among others (UNEP, 2016). The data sources for these indicators are primarily qualitative and involve surveys, questionnaires, interviews, and reviews of existing plans or procedures.

Output focuses on the activities related to procurement itself. The indicators measure the extent to which GPP is being applied in actual procurement processes. This includes the number or percentage of tenders that incorporate green criteria, the volume and value of green products purchased, and the value of contracts that include green criteria. Data sources for output indicators are typically found in e-procurement platforms, surveys, procurement databases, and through tender documents and reports analysis (Open Contracting Partnership, 2021; SWITCH-Asia, 2020; UNEP, 2016).

Outcomes refer to impacts or benefits resulting from GPP. When measuring the outcomes of GPP, the methodologies used depend largely on the objectives of the evaluating authority, among other factors (SWITCH-Asia, 2020; UNEP, 2016). These methodologies also differ based on the definitions used for "green" or "sustainable," scope and baseline, the conversion factors or tools utilized for estimating benefits, and the selected indicators. Typically, the outcomes of GPP are commonly measured by environmental impacts or benefits—for instance, energy savings, waste reduction, and reductions in GHG emissions (UNEP, 2022). These methods range in complexity from the use of simple unit conversion factors to complex approaches that use life-cycle assessment models (Dragos et al., 2013). Data sources for these methodologies include surveys, a review of product attributes, purchasing records of sustainable versus non-sustainable products, and suppliers' reports (Ecoinstitut, 2013; UNEP, 2016).

However, despite its important role in building buy-in for GPP—as many authorities need quantifiable proof of GPP outcomes—monitoring GPP impact is still rare in practice. Most countries that have monitoring and evaluation systems in place tend to measure outputs more than outcomes (UNEP, 2017b). Approaches to evaluating environmental benefits could be designed based on products purchased and environmental performance (Ecoinstitut, 2013). For the approach based on purchased products, direct or proxy analysis can be conducted. Direct evaluation requires an in-depth data analysis of each product but offers a highly accurate assessment of environmental benefits. However, due to its data-intensive nature, many organizations opt to use proxies to get an overall idea of the environmental benefits related to GPP. This is inevitably less accurate and may underestimate or overestimate benefits, but it is simpler, and data is easier to track. For instance, rather than using specific energy consumption data for each television, the proxy method might apply an energy-efficiency rating, like a class-A label, to assume standard energy usage for all televisions in that category. This simplification avoids the need for detailed energy consumption records for each unit (Ecoinstitut, 2013).

The environmental performance-based approach, on the other hand, utilizes indirect evaluation. It assesses an organization's performance—applicable to both the supplier and the procuring organization—against environmental parameters such as energy or water consumption and waste production (Ecoinstitut, 2013). After defining the environmental characteristics through direct measurements of products or proxies and setting the environmental parameters, the next step is to translate these into environmental benefits using data on environmental impact factors. These factors facilitate the conversion of characteristics and parameters into assessments of environmental benefits. The impact factors may encompass the entire life cycle of a product or focus on a single phase (Ecoinstitut, 2013). For instance, for electricity, the impact could be represented as grams of CO_2 emitted per kWh used, which is a mass-based approach. Alternatively, for other scenarios, it could be the average CO_2 emissions per unit of monetary expenditure, representing a spend-based analysis.

While GPP broadly covers various environmental impacts, monitoring GHG emissions or CO_2 emissions in public procurement is increasingly becoming a central concern for many governments. The procurement of goods and services by the public sector contributes to approximately 15% of global GHG emissions (WEF, 2022). Therefore, tracking emissions from public procurement can help countries assess whether they are on track to achieve their climate goals.

2.2 How to Monitor the CO_2 Impacts of Public Procurement

Many methods and tools are used to measure GPP benefits in terms of GHG emissions or CO_2 emissions. In their report on *Measuring and Communicating the Benefits of Sustainable Public Procurement*, UNEP (2016) presented a variety of general methods and tools employed to measure environmental benefits in terms of GHG emissions reductions (Table 2). In this report, the methods are further separated into three categories based on their scope and applicability, which are product-level information, organizational-level methods, and assessment tools and models.

Table 2. Methods, tools, and data sources for monitoring and measuring GHG emissions originating from GPP

	General methods	Tools	Data sources
Product-level information	Environmental Product Declarations (EPDs), eco-labels, third-party-verified product data sheets	EU Ecolabel, Energy Star label	Surveys, reviews of product attributes, purchasing records of sustainable versus non-sustainable products, and suppliers' reports
Organization-level	Emissions inventories (Scopes 1, 2, and 3), environmental management systems (EMSs)	CO_2 Performance Ladder (CO_2PL), Supply Chain Environmental Sustainability Scorecard	
Assessment tools and models	Life-cycle assessment (LCA), Economic Input-Output (EIO) LCA, avoided emissions, offsets, CO_2 equivalents, global warming potential	EnviroCalc, DuboCalc, life-cycle costing and CO_2 assessment tool (LCC-CO_2), Building for Environmental and Economic Sustainability Software, carbon savings calculators	

Source: Ecoinstitut, 2013; UNEP, 2016, 2022; World Bank, 2022.

Product-level information pertains to the specific environmental impact of individual products. To assess and communicate these impacts, methods such as EPDs, eco-labels, and third-party-verified product data sheets are commonly utilized. The EPD method is a standardized document that summarizes the environmental performance or impact of a product throughout its life cycle. EPDs adhere to specific guidelines and requirements set forth by international standards, such as ISO 14025, ensuring consistency and comparability across different products and industries. Examples of tools employed for this are the EU Ecolabel and the Energy Star label, which provide certifications indicating a product's environmental performance.

The environmental impact at the organization level includes the implementation of EMSs and Scopes 1, 2, and 3 emission inventories by both the supplier and the procuring agency. An EMS is one component of an organization's broader management system that helps both public and private entities systematically address key environmental issues, where its goal is to lessen the environmental footprint of an organization's activities (Rusko et al., 2014). It does this by establishing formalized policies, procedures, and practices to manage environmental aspects and minimize environmental impacts, emphasizing continuous improvement (McGuire, 2014). At the organizational level, examples include the CO_2PL and the Supply Chain Environmental Sustainability Scorecard, frameworks used to evaluate and enhance an organization's carbon footprint and overall environmental sustainability. The CO_2PL, in particular, supports green procurement by encouraging suppliers to reduce their CO_2 emissions through a carbon management system and the potential advantage that can be gained at the award stage (OECD, 2022).

As for assessment tools and models, methods include LCA, EIO-LCA, and calculations of avoided emissions and offsets, among others. An LCA is a methodology for measuring and analyzing environmental impacts related to the life cycle of products, services, and processes (International Organization for Standardization, 2006). Typically, an LCA is utilized to compare different products, activities, and processes, or it can be used independently to identify critical areas of environmental impact throughout the life cycle (Mazzi et al., 2017). Examples of such assessment tools include EnviroCalc, DuboCalc, LCC-CO_2, the Building for Environmental and Economic Sustainability Software, and various carbon savings calculators. These tools are used to calculate the environmental impacts of products and projects, including life-cycle costs and carbon emissions.

These three methods are interrelated in that they can be integrated to give a comprehensive assessment of environmental impacts, including GHG emissions, in public procurement and beyond. For example, using an LCA with an EMS is considered an effective approach for improving organizational environmental profiles. While EMSs focus on processes and LCAs focus on products, they can be complementarily employed for a more comprehensive environmental approach (Mazzi et al., 2017). An LCA can add scientific data to an organization's environmental performance evaluation. It helps identify the environmental impacts of an organization's activities both within and outside of the organization (Mazzi et al., 2017). The CO_2PL is an example of an EMS that integrates aspects of an LCA.

Commonly, the data for these methods and tools are collected through surveys, suppliers' reports, reviews of product attributes, purchasing records of sustainable versus non-sustainable products, and suppliers' reports (Ecoinstitut, 2013; UNEP, 2016). For instance, surveys may also take the form of subjective qualitative assessments, wherein the contract manager of the contracting authority is asked to evaluate the extent to which the contracted supplier has fulfilled their green commitments.

Box 1. The CO_2 Performance Ladder: A comprehensive tool for GPP and carbon emissions management

The CO_2PL is both a CO_2 management system and a green procurement tool that helps organizations reduce their carbon emissions. With a certificate on the ladder, organizations can earn an award advantage in procurement processes. CO_2PL was created in 2009 by the Dutch railway manager ProRail, and since 2011, it has been owned and managed by the Foundation for Climate Friendly Procurement and Business (SKAO), which is an independent and non-profit organization.

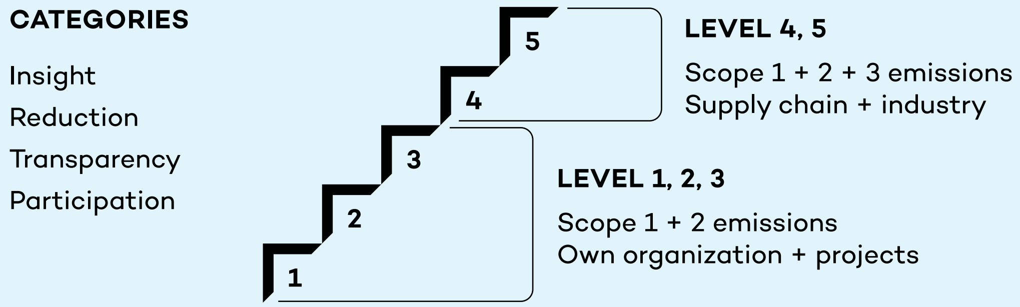
Over 5,000 organizations from the Netherlands, Belgium, and beyond have achieved certification through the CO_2PL. Moreover, over 300 contracting authorities in Belgium and the Netherlands utilize this ladder in their green procurement processes. Studies have shown that CO_2PL is an effective instrument for reducing CO_2 emissions (Schep et al., 2023) and that organizations certified under the CO_2PL cut carbon emissions twice as fast as non-certified companies in the Netherlands (Rietbergen et al., 2017). CO_2PL has also been mentioned as best practice in green procurement by OECD (2015), the IPCC (2022), and the WEF (2022).

The CO_2PL operates on the Plan-Do-Check-Act cycle, emphasizing continuous improvement for organizations aiming to reduce carbon emissions or achieve carbon neutrality. The CO_2PL certificate has five levels, with levels 1 to 3 focusing on identifying and reducing the emissions related to the organization and its projects (Scopes 1 and 2). At levels 4 and 5, organizations also start considering their upstream and downstream emissions, including emissions in the supply chain and in the services and products that they supply (Scopes 1, 2, and 3).

The levels are based on an organization's performance in four categories:

1. Insight: to determine different streams of energy and assess the organization's carbon footprint.
2. Reduction: to set ambitious goals for CO_2 emissions reductions.
3. Transparency: to structurally communicate the organization's CO_2 reduction policies.
4. Participation: to engage in business sector initiatives concerning CO_2 emissions reduction.

Figure 1. The Ladder System



Source: Adapted from SKAO, 2023a.

To keep their certification, companies must track their emissions reductions and be monitored annually by independent third-party auditors to ensure that they are meeting their targets. Contracting authorities use the CO_2PL as a voluntary award criterion in tenders to reward companies that are working on reducing their carbon emissions when bidding for public contracts. They do this by giving them an award advantage, either as extra points or as a fictitious discount on bids that meet the CO_2PL requirements. The higher an organization reaches on the CO_2PL, the greater the award advantage it receives. The party giving out the contract determines the award advantage an organization receives at each level of the ladder.

The CO_2PL can also facilitate GPP monitoring efforts, as monitoring is an important aspect of the CO_2PL. It enhances the tracking of energy usage and CO_2 emissions following its implementation (Schep et al., 2023). The Plan-Do-Check-Act cycle of the CO_2PL ensures that organizations have clear reduction goals and monitor their progress over time, ensuring a long-term focus on CO_2 reduction (Breman et al., 2022).

3.0 Challenges in Monitoring GPP Impacts

Despite the benefits and importance of monitoring GPP, several challenges persist, ranging from foundational issues of defining objectives and targets to practical difficulties, such as data collection, legal frameworks, and the decentralized nature of public procurement.

The main challenges faced in monitoring GPP impacts include the following:

The Absence of Clear Objectives or Targets

The absence of clear objectives in monitoring GPP impacts presents a significant challenge, as without well-defined goals, it becomes difficult to design appropriate monitoring frameworks and effectively measure progress. The lack of a clear mandate or strategy for GPP is also one of the main barriers to the implementation of GPP (Brammer & Walker, 2011; Testa et al., 2016). Furthermore, how "green" and "sustainable" are defined, the scope of monitoring outcomes, and baseline settings also need to be defined, as the lack of uniformity makes the measurement difficult (UNEP, 2016).

The Decentralized Nature of Procurement

Government procurement is often highly decentralized, which adds to the complexity of procurement activities in the majority of countries (WEF, 2022). While national governments handle some centralized procurement, subnational governments often manage their own purchases. Moreover, procurement within public organizations is often fragmented, as each department has its own procurement officers; in some cases, individuals who are not procurement specialists might handle purchasing tasks, among other duties (GIZ, 2022). This decentralized nature makes it more difficult for governments to monitor the outcomes of GPP, as monitoring requires extensive communication, standardization, and coordination among procurers to ensure alignment in tracking the environmental impact, as well as data collection on public procurement more generally.

A Lack of Data and Transparency

Data plays a vital role in measuring and tracking the environmental impacts of GPP. The Open Contracting Partnership is a key organization that supports countries in setting up better and more transparent open data systems for monitoring public procurement. Obtaining high-quality data poses a significant challenge to the GPP monitoring and evaluation process. The data architecture of procurement systems is often not designed with capturing data for GPP monitoring in mind. This challenge pertains to data on the use of GPP criteria, green certificates, planned future spending, and supplier performance, among others (Open Contracting Partnership, 2021). Soylu et al. (2022) also highlight issues with data quality and poor data publication practices on procurement (Soylu et al., 2022). For example, in Tenders Electronic Daily, the official European portal for public procurement, tenders falling below a certain threshold are frequently omitted. A significant portion of procurement volume, approximately 60%–80%, is under the EU thresholds. While some countries, such as Belgium and Portugal, report these figures effectively on their national platforms, the data is generally absent in the Netherlands. The data provided in Tenders Electronic Daily also tend to be poorly structured, incomplete, and not robust enough to support advanced analyses (Soylu et al., 2022).

In the case of measuring carbon emissions in public procurement, a lack of transparent data on public sector emissions makes it challenging to set emissions baselines; set realistic and achievable decarbonization targets; compare data across products, sectors, and countries; and track progress. In addition, discrepancies between different official data sources also make this effort more difficult (WEF, 2022). Looking at the state of climate accounting of public procurement in Nordic countries, the Nordic Council of Ministers (2022) highlights a need to harmonize carbon footprint data for carbon emissions.

Diverse Methods for Measurement

There are numerous standards and methods for measuring the impacts of GPP on the climate. This variety can be confusing and places a burden on suppliers and contracting authorities (Nordic Council of Ministers, 2022). The diversity in methods pertains to the data used to estimate climate impact. If data is derived based on these varied methods, its utility for comparisons, benchmarking, and aggregation becomes limited. For example, the ability to compare EPDs and the varied approaches used in their LCAs are seen as the main challenges affecting the credibility of their outcomes (Azarijafari, 2021). Using case studies in the United Kingdom, the United States, Italy, and the Netherlands, Hafsa et al. (2021) found that estimating the impacts of SPP is challenging due to variations in how different governments measure public procurement. Another problem arises from the use of a spend-based approach in measuring carbon emissions. This approach calculates emissions by correlating them with the cost of procured items, often without distinguishing between green and conventional products. This can lead to inaccuracies, as it might imply higher emissions when more money is spent on greener, often more expensive, options, failing to reflect the actual environmental benefits of these purchases (Scottish Government, 2022).

A Lack of Knowledge and Skill

Monitoring and evaluating the outcomes of GPP requires specialized knowledge and skills that may or may not be available within an organization (UNEP, 2016). When using the available tools to conduct GPP practices, sometimes there is a lack of knowledge about the correct methods or procedures (Zhu et al., 2013). For example, the application of LCA tools in the procurement process needs specialized knowledge, as it is highly complex, and the organization often lacks knowledge and skills regarding LCA and other related GPP tools (Scherz et al., 2022). To fully leverage the resources at their disposal, procurement staff must engage in ongoing education and training, as GPP is a highly dynamic and complex target (Liu et al., 2020).

Cost

Measuring the outcomes of GPP can be costly (UNEP, 2016). Public agencies may need a lot of expertise to effectively monitor and evaluate GPP. This involves a significant amount of upskilling or hiring additional staff, which can impose a financial burden on some departments (Keaveney & Butler, 2014). Public agencies often have limited budgets and must make trade-offs between different priorities and projects. Allocating funds to measure

GPP outcomes can be challenging to justify when weighed against other competing initiatives, despite the potential for substantial benefits (UNEP, 2016).

Legal and Policy Issues

UNEP (2016) highlights that legal challenges exist when assessing SPP/GPP outcomes. The scope of the delegated authority, which varies by jurisdiction and agency, directly affects its ability to implement GPP initiatives, demand data, and engage with suppliers for additional information. Additionally, the legal and policy definitions of sustainability are not consistent across different jurisdictions, making it challenging to uniformly define, measure, and compare the impacts of sustainability.

Communication Challenges

Communicating the outcomes/impacts of GPP is crucial to continue building the case for GPP. However, several challenges persist. According to UNEP (2016), these challenges include varying reporting requirements among different agencies, affecting the consistency and comprehensiveness of how GPP impacts are communicated. Agencies with voluntary reporting may choose to showcase their program's effectiveness to secure internal support, but this can vary widely between organizations. Moreover, the complexity of GPP information poses a challenge, as it requires simplifying technical details for a non-technical audience without oversimplifying and misrepresenting the facts. The diversity of the audience, encompassing procurement officers, policy-makers, and the public, each with different levels of understanding and interest in sustainable practices, complicates tailoring the communication effectively.

4.0 Case Studies

The case studies described in this section serve as important benchmarks, providing valuable lessons, best practices, and guiding principles for countries looking to enhance their monitoring GPP practices. In this chapter, we explore a selection of case studies on monitoring GPP.

4.1 South Korea

South Korea has been developing and implementing GPP policies since the 1990s. GPP has gained significant momentum, particularly since the enforcement of the Act on Promotion of Purchase of Green Products in 2005, which is widely recognized as a best practice example (OECD, 2015). The act mandates that all government agencies must submit an annual plan outlining their green procurement implementation strategy for the upcoming year, along with a performance report detailing the quantity of green products purchased. This submission is made to the Ministry of Environment (MoE) for evaluation and monitoring.

South Korea is at the forefront of using and integrating electronic procurement systems and platforms to implement and monitor GPP (OECD, 2022). It is one of the few countries with a central emissions database, which has enabled it to evaluate the impact of its green procurement policy since 2005 (WEF, 2022). They introduced the Korean Online E-Procurement System (KONEPS), KONEPS e-shopping malls, Korea Environmental Industry and Technology Institute's (KEITI's) Green Procurement Information System (GPIS-I), and the recent implementation of the Public Procurement Data System for efficient GPP data collection and reporting across all government levels. As a result, Korea's GPP monitoring system is seen as a global benchmark.

To evaluate the progress of GPP, the MoE monitors two main aspects (UNEP, 2019). One focuses on how many public authorities have GPP plans and their implementation reporting. The other aspect measures the actual green product purchases by their number, economic value, and percentage among products with the Korea Eco-Label and Good Recycled Mark. These products include building and construction materials, electronic/electric/information and communication technology (ICT) equipment, office appliances, furniture, office supplies, and others. Using the data gathered on the level of purchase of green products, KEITI evaluates the sustainability impact of GPP (see Box 2). The sustainability impacts are estimated in terms of CO_2 reduction, economic benefits through the reduction of environmental impacts, and job creation (UNEP, 2019).

To communicate the benefits of GPP and promote its further implementation, KEITI and the MoE publish impact results each year. In 2017, the reduction of CO_2e emissions was estimated at 665,000 tonnes, or around 0.1% compared to South Korea's total CO_2 emissions in that year. The economic benefits linked to the reduction of several environmental impacts from total green purchases totalled USD 35.4 million, and, on top of that, the results also show that 4,415 new jobs were created in the green economy. Results are conveyed in a manner that the general public can easily understand, often using social math or equivalencies. For instance, the reduction in CO_2 equivalent emissions achieved through GPP is typically illustrated by comparing it to the decrease in vehicle exhaust emissions in Seoul over a specific period (UNEP, 2019). This assessment of the benefits of GPP in South Korea has been crucial in highlighting GPP's positive effects and strengthening political support (UNEP, 2019).

Several factors contribute to South Korea's effectiveness in GPP monitoring. There is strong government support for green procurement, as noted by UNEP (2017a), with key agencies like the MoE, KEITI, and the Public Procurement Service working together (GIZ, 2022). The monitoring and evaluation of GPP are integrated into their e-procurement systems, and there is a mandatory reporting requirement for all public authorities (GIZ, 2022). South Korea also benefits from a robust eco-label system that clearly defines sustainability and aids in tracking green purchases and their environmental impacts (Asia Pacific GPP Network, 2021). KEITI also has a dedicated team consisting of four people for GPP monitoring.

Box 2. Environmental impact calculation of GPP in South Korea

In calculating the environmental impact, eco-labelled products are being compared to conventional products using LCA data, which is sourced from the national life-cycle inventory analysis database (UNEP, 2019). Initially, environmental benefits were only assessed in terms of annual CO_2e emission reductions for 19 product categories within the Korea Eco-Label. However, since 2015, the assessment has expanded to encompass a broader range of environmental impacts, utilizing LCA data for a list of 134 product categories (SWITCH-Asia & UNEP, 2020).

Ten environmental impact factors are assessed based on available data, including energy savings, resource-saving, and toxic substance reduction (SWITCH-Asia & UNEP, 2020). For each category, two aspects are compared: an average or proxy eco-labelled green product against a proxy conventional product, taking into account the environmental impacts incurred throughout the product's life cycle. The proxy eco-labelled products embody the average value of the test results of products that meet the Korea Eco-Label criteria, while the representative conventional product reflects the average value of the test results of products that fall short of these criteria. In the absence of test results, the environmental standards established by the Korea Eco-Label criteria serve as proxy values for conventional product impacts, assuming that representative eco-labelled products outperform the standards set by the Korea Eco-Label (SWITCH-Asia & UNEP, 2020).

The government computes the savings from environmental externalities by applying monetization factors to the environmental impact differences between green and conventional products, where its formula is:

> *Annual economic savings per product group = quantity of green products purchased during the year × (environmental parameters of conventional product − environmental parameters of green product) × economic conversion factors of the environmental parameters*

The following example (Table 3) illustrates the calculation of cost reduction achieved with green purchases for personal computers for the years 2009–2013. The impact on emissions reductions is determined by multiplying the total green units purchased and the emission reduction factor, subsequently dividing by a thousand to transition the measurement from kilograms to tonnes of CO_2 equivalent (CO_2e). Additionally, the total externality cost savings were calculated by multiplying the total number of green products purchased each year by the sum of the cost-saving factors from reduced noise emissions and lower energy consumption attributable to each unit.

Table 3. Example of the calculation of the reduction in environmental costs for personal computers, 2009–2013

	2009	2010	2011	2012	2013
Total number of green products purchased (units)	429,074	269,820	307,730	310,370	324,278
CO_2e emissions reduction factor for the life cycle of the product (5 years) using LCA data (kg)	477	477	477	477	477
Externality cost-saving factor due to lower noise emissions of the green product (USD/unit)	15.04	15.04	15.04	15.04	15.04
Economic saving factor due to the lower energy consumption of the green product throughout the life cycle (USD/unit)	20.43	20.43	20.43	20.43	20.43
Impact reduction achieved through green purchases (tonnes of CO_2e)	429,074×477/1000 = 204,668 tonnes of CO_2e saved	128,704	146,787	148,046	154,681
Externality cost savings achieved through green purchases (million USD)	429,074×(15.04+20.43) = 15.2 million USD saved	9.57	10.92	11.01	11.50

Source: Adapted from SWITCH-Asia & UNEP, 2020; UNEP, 2019.

4.2 Japan

In 1994, the Japanese government published an action plan on green government operations, and in 2000, the government enacted the Act on Promoting Green Procurement (UNEP, 2019). The act mandates that every ministry and their subordinate entities annually establish and disclose a GPP plan, including self-set goals for designated priority products and services as defined by the government. Additionally, these bodies are required to submit a report of their GPP activities to the MoE after each fiscal year and to publicly share this information. The GPP policy is mandatory for central government agencies but voluntary for local public authorities (UNEP, 2019).

Since 2001, Japan has monitored GPP implementation to evaluate policy results, and since 2006, it has also established a method for estimating the environmental impacts of GPP (UNEP, 2019). This estimation process is carried out annually and is applied only to central government agencies. Although the central government has to report on more than 260 products covered by its GPP policy, benefits are only calculated for 19 product categories, including imaging equipment, office stationery, climatization equipment, appliances, indoor lighting, tires, textile products, vehicles, and building solutions and materials (see Box 3). In Japan, a digitized data tracking system does not exist (Hasanbeigi & Shi, 2021). Rather, the MoE in Japan collects data on GPP implementation by providing a standardized reporting form to central ministries and their agencies. Each agency completes the form with the number of products purchased each month, and this data is then automatically calculated into an annual total. Based on the collected data, the MoE can determine the overall quantity of green products purchased (in units); the proportion of green products purchased relative to the total quantity of products purchased, expressed as a percentage; and an estimate of the GHG emissions reductions achieved through the purchase of green products for 19 product categories (SWITCH-Asia & UNEP, 2020). From that calculation, in 2016, the total estimated annual savings since 2006 from all these products amounted to 35,767 tonnes of CO_2e, or around 2.7%, compared to Japan's total CO_2 emissions in that year (MoE, 2017).

Box 3. Environmental impact calculation of GPP in Japan

The Japanese government measures the environmental benefits of GPP in terms of GHG emissions (CO_2e) reductions for 19 product categories. To calculate this, a proxy green product is defined for each product category based on the minimum green specifications set in the GPP policy (SWITCH-Asia & UNEP, 2020).

For products that can impact energy usage or consumption (for instance, tires), CO_2e emissions are calculated based on the total energy consumption during the use phase over a specific period, which varies by product and the emissions factors of the energy source used. On the other hand, for products that do not consume energy (such as stationery), CO_2e emissions are determined through different methodologies, relying on existing research to convert environmental impacts into CO_2e (SWITCH-Asia, 2020).

The benefits of these practices are then measured by comparing the level of GPP in a given year against the market share of eco-friendly products back in 2000, which was before the act came into effect. The calculation formula is the following:

Total CO_2e emissions saved = Total number of products purchased during the year × (% that is green − % of market share of the green product in 2000) × conversion factors of the green product characteristics to CO_2e emissions × years of use of the product

The example provided in Table 4 demonstrates how to calculate the reduced impact of green purchases of copying equipment in 2016. The calculation is based on the total number of green products purchased, adjusted for the increase in market share from the years 2000 to 2016 and the reduction in annual power consumption between current green products and those from the year 2000. This is combined with the emission factor for electricity and the product's lifespan. The resulting environmental impact is a reduction of 2,924 tonnes of CO_2e.

Table 4. Example of the calculation of impact reduction obtained with green purchases for copying equipment in 2016

Total number of products purchased	11,266
Percentage of green products purchased from the total	99.57%
Percentage of the market share of green products in 2000	33.30%
Annual power consumption of products in 2000	302 kWh/copier
Annual power consumption of proxy green products	150.8 kWh/copier
Electricity emissions factor	0.518 kg CO_2e/kWh
Years of use of the product	5
	11,266 × (0.9957-0.333) × (302-150.8) × 0.518 × 5 =
Impact reduction obtained with the green purchases	**2,924 tonnes of CO_2e saved**

Source: Adapted from SWITCH-Asia & UNEP, 2020; UNEP, 2019.

4.3 Slovenia

Slovenia has several supportive policies and regulations in place to promote GPP. The legal foundation for GPP is established in the Public Procurement Act (2015), commonly referred to as the PPA (Official Gazette, No.91/15 and 14/18), allowing the government to include environmental considerations in procurement for specific product categories. The Decree on Green Public Procurement (2021), which has been updated in its latest iteration (Official Gazette, No. 121/21), details 22 product categories where environmental aspects are mandatory. This decree represents the latest iteration and continues to refine the environmental considerations and objectives previously established for GPP in Slovenia (Lakić et al., 2022). This decree also incorporates European Directives that set the GPP criteria. Moreover, in 2019, Slovenia launched the Care4Climate project under the EU Life

Programme. This project focuses on initiatives like awareness-raising, education, and training and aims to promote the transition to a low-carbon society. GPP is identified as one of the project's key areas (Bechauf et al., 2022).

As part of the activities of the Care4Climate project, in 2022, a comprehensive analysis of the sustainability impacts of GPP was launched. This analysis was carried out by the Ministry of the Environment and Spatial Planning of Slovenia, in cooperation with the Laboratory for Energy Strategies (Faculty of Electrical Engineering, University of Ljubljana) and Austrian partners ConPlusUltra GmbH. The purpose of the analysis was to monitor the effects of GPP on market share, GHG reduction, other environmental impacts, and economic and social impacts. The study will serve as a basis for continuous monitoring of GPP impacts. Furthermore, the study will provide a valuable tool for enhancing the design and implementation of future GPP initiatives, supporting public procurers and suppliers, and promoting GPP practices. The analysis covered six out of 22 products from the Decree on GPP, including electrical devices (computers, refrigerators, dishwashers, and water heaters), road vehicles, and the design and/or construction of buildings (Lakić et al., 2022). Plans for future analyses include expanding the range of products covered.

The study employed diverse strategies to set baselines and indicators, as well as various tools to calculate impacts, depending on the specific subjects being analyzed (see Box 4). The adopted methodology assessed both directly measurable impacts (certain economic and environmental outcomes like emissions) and those determined indirectly (like social impacts). The analysis evaluated the environmental impacts of GPP in several ways. First, it directly measured changes in GHG emissions and indirectly estimated the effects on pollution, waste generation and recycling, threats to biodiversity, smog generation, and various other factors. In terms of economic impacts, the study compared energy and water consumption costs and their economic implications. Second, it looked at indirect factors like the quality of goods, services, and works. Other aspects considered were supply and demand, competition and fair-trade protection, the use of local producers and products, innovation, and more. For social impacts, the analysis indirectly measured the impact on individuals and communities resulting from an action or inaction, activity, project, program, or policy. This included working conditions, employment, public health, safety, culture, and various other aspects.

The data for this analysis is the data collected from selected green public contracts and was sourced from the Electronic Public Procurement of the Republic of Slovenia portal,[1] which is openly accessible to the public. The data on green public contracts are classified based on code lists (CPV codes; Common Procurement Vocabulary). Based on the data available, broadly applicable indicators for the chosen product groups were established, enabling the use of these indicators across a wide range of groups. For assessing the impact of GPP, a baseline as a reference point for comparisons was set. This baseline varies for different product groups; it could be an energy label or the Energy Star program label, which collects energy consumption data for products and appliances. This is mainly relevant for electronics, and indirectly for vehicles and building construction. If no such label exists, the baseline is the average of a comparable class in the GPP product group. The approach to establishing baselines and indicators differs based on the specific items being analyzed (Lakić et al., 2022).

[1] https://ejn.gov.si/statist.html

To estimate the impact of the Decree on GPP for individual areas within the selected green public contracts, the study extrapolates the data segment by segment. For example, to estimate the total savings of all computers purchased according to the Decree on GPP, data from the years 2018, 2019, and 2020 will be used. These savings will then be extrapolated to estimate the total savings for all the contracts. Simple linear extrapolation is used to estimate savings beyond the scope of their study for all types of implemented green public contracts that they have analyzed.

The results of the analysis show that in most cases, contracting authorities follow the guidelines set out in the Green Public Procurement Regulation (Lakić et al., 2022). This has resulted in energy and financial savings, reduced GHG emissions, and positive impacts on society. The study shows that by complying with the core requirements of the GPP regulation, in 2018, 2019, and 2020, contracting authorities saved a total of 301,480 MWh of energy, reduced water consumption by 10,445,000 m^3, and reduced CO_2 emission into the atmosphere by 101,506 tonnes, which is equal to 0.5% of the total CO_2 footprint in Slovenia. The savings in water and energy also reduced economic costs, saving customers EUR 61 million (Lakić et al., 2022).

The study also mentions challenges in measuring the impact of GPP in Slovenia, which primarily concerns navigating the e-procurement database and collecting data to measure GPP's impact. Items like refrigerators often required direct contact with authorities for specific information, as that specific information was not clearly defined in the tender documentation. There is also inadequate information about public works contracts, as many construction contracts lacked specific details beyond the requirement to meet the basic environmental criteria of the Decree on GPP. Assumptions had to be made about the use of energy-saving features, like efficient lighting and toilets, to estimate savings. Contracts explicitly stating a 30% wood usage in construction were rare. Furthermore, there was a low number of public contracts and a lack of information for some products, such as refrigerators, dishwashers, and electric heaters, with available orders often being too specialized, making savings calculations particularly challenging (Lakić et al., 2022).

Box 4. Environmental impact calculation of GPP in Slovenia using the example of the design and/or construction of buildings

In measuring the sustainability impact of the design and/or construction of buildings, various indicators and their corresponding methods (direct or indirect) were established, as shown in Table 5. The analysis is conducted on a select group of buildings, as defined by the latest amendments to the Decree on GPP, such as residential buildings for special purposes or social groups, administrative and office buildings, and buildings of general social interest.

Environmental impacts of design and/or construction of buildings, with associated indicators and methods of measurement (direct or indirect):

1. CO_2 emissions (indirect)
2. Energy consumption (indirect)

3. Water consumption (indirect)
4. Use of wood in construction (indirect)
5. Air quality (indirect)
6. Quality of the living environment (indirect)

Looking in more detail at the calculation of the environmental impacts, the analysis focuses on the following main areas: minimum use of 30% wood in construction, installing energy-efficient lighting to reduce electricity consumption and CO_2 emissions, and implementing dual flush toilets to reduce water consumption.

In the assessment of wood utilization, the proportion of wood used in construction is verified against public contracts. This proportion informs the estimation of CO_2 emission reductions, leveraging wood's capability to store CO_2 (as research indicates that 1 m^3 of wood can reduce atmospheric CO_2 by 2 tonnes). For GPP buildings, an equation models the CO_2 storage potential over a decade, based on the wood's lifespan and percentage used in construction, summarized by the formula:

$$\Delta E_{co_2,build\ GPP} = \Delta E_{CO_2,house} \times 2 \times 0.3 \times (10/60) = 7\,t\ CO_2$$

This suggests that a building with 30% wood can store about 7 tonnes of CO_2 over 10 years.

Energy savings and CO_2 reduction from energy-efficient lighting in Slovenia's buildings are quantified using a specified calculation method. This method adheres to the national guidelines for calculating energy savings. The formula to compute annual savings involves entering the quantity of various lamp types—like light-emitting diode (LED) and compact fluorescent lamps (CFLs)—into a designated calculation tool, with the formula:

$$\Delta W_{ann} = \Delta W_{LED} \times N_{LED} + \Delta W_{CFL} * N_{CFL} + \Delta W_{T8\rightarrow T5} \times N_{T8\rightarrow T5} + \Delta W_{eb} \times N_{eb} + \Delta W_{sensor} \times N_{sensor}.$$

This captures the savings from different lighting upgrades and installations. The calculated annual savings, represented by ΔWLED, ΔWCFL, ΔWT8→T5, ΔWeb, and ΔWsensor, reflect the energy-efficiency gains from switching to LED and CFLs, upgrading from T8 to T5 fluorescent lamps, installing electronic ballasts, and implementing occupancy sensors. N_{LED}, N_{CFL}, $N_{T8\rightarrow T5}$, N_{eb}, and N_{sensor} denote the counts of these respective changes. When specific data is unavailable in tender documentation, estimates from energy experts are used.

Water savings from dual flush toilets in GPP buildings are estimated using a formula that calculates the difference between the standard and dual flush systems, multiplied by the number of uses per day and the number of toilet bowls. Other environmental impacts are indirectly assessed through literature examples.

In total, for the years 2018–2020, the combined reduction in CO_2 emissions from the use of 30% wood in construction and the installation of energy-saving lighting amounted to 429.1 tonnes of CO_2 emissions. Additionally, water savings reached approximately 56,260 m^3.

4.4 Denmark

Denmark has recognized the environmental responsibility of public purchasers since 1991. This commitment was formalized with the release of the Danish Environmental Protection Agency's first strategy, which specifically focused on promoting GPP in 1991 (Riisgard, 1997). In 2020, the government launched a new strategy to promote greener public procurement. The aim is to reduce the carbon footprint in public procurement, including procurement for transportation and the construction of public buildings. To track progress, an annual process was established to calculate and project the carbon footprint of public procurement. It requires a unified approach to categorize and evaluate procurement across different levels of government (municipal, regional, and national). The calculation utilizes a detailed data set comprising product descriptions from each line item in the millions of invoices (invoice data) issued to various public entities over a year (Økonomistyrelsen, 2020).

Invoice data is mainly matched with emission factors from the EXIOBASE calculation model, which is an Environmentally Extended Multi-Regional Input/Output table (Økonomistyrelsen, 2020). Multi-regional input-output (MRIO) tables are comprehensive statistical datasets that document the interconnectedness of industries across various regions. These tables capture detailed information on industries' production activities, energy consumption, value added, land use, and trade flows. By tracking the inputs utilized by each industry to generate its outputs, MRIO tables enable the tracing of production processes back through the supply chain. The "EE" designation indicates that these MRIO tables are supplemented with a comprehensive range of environmental data, including information on heavy metals, particulate emissions, and CO_2 and CO_2e emissions. This enables the calculation of the carbon footprint associated with each stage of a product's or service's journey through the value chain.

The process of assessing an industry's carbon footprint involves initially calculating its total emissions by summing its direct emissions and those it indirectly causes in other industries (Økonomistyrelsen, 2020). This total is then compared to the industry's overall value output to determine emissions per unit of currency (per DKK) for the goods and services provided. In the context of public procurement, the public sector is assumed to be responsible for a share of these emissions proportional to its procurement volume. Specifically, the climate footprint of public procurement is calculated by multiplying the amounts on invoices for goods and services from an industry by that industry's emissions per procurement DKK, as determined by the global input-output database EXIOBASE. This approach provides a quantifiable measurement of the environmental impact of public sector purchasing decisions (Økonomistyrelsen, 2020).

In 2019, the total carbon footprint of public procurement in Denmark was calculated at 14.3 million tonnes of CO_2e. Approximately one third of these emissions occurred within Denmark, while the remaining two thirds were associated with countries from which Denmark imports raw materials, semi-finished products, finished goods, and services (Økonomistyrelsen, 2020). The calculations were also performed for 2020 and 2021, with total CO_2 emissions amounting to 15.1 million tonnes of CO_2e in 2020 and 16 million tonnes of CO_2e in 2021 (Danish Energy Agency, 2023). From 2019 to 2021, the construction sector was responsible for the largest carbon footprint. The procurement of other goods and health services, which includes increased expenses for pharmaceuticals and medical equipment during the COVID-19 pandemic, and the "energy and utilities" sector, were the second and third largest contributors to the carbon footprint, respectively (Danish Energy Agency, 2023).

In the process of calculating the carbon footprint, several challenges have arisen. At the state level, there are 82 procurement categories, which may not capture the necessary detail for precise carbon footprint calculations for certain services. Furthermore, when details are not clear, items are often placed into "unknown procurement" categories, which complicates the accurate tracking of their environmental impacts. There is an ongoing effort to recategorize and improve the procurement data. Another issue stems from a lack of data that would allow more detailed approaches, such as quantity-based and product-specific methods for carbon footprint calculations. The current method primarily relies on an expense-based method due to the availability of data. In 2020, 89% of the carbon footprint calculations were expense-based, while 11% were quantity-based, mainly for fuel and energy consumption. There is also an effort to increase the quantity-based part of the calculation.

As most purchases are valued in monetary terms, the results of the calculation model are heavily influenced by price fluctuations. Consequently, more expensive procurement leads to a larger reported carbon footprint. This also presents a limitation to the model, particularly in cases where an alternative, green product is more expensive than its conventional counterpart (Danish Energy Agency, 2023). This stresses the importance of the current effort to improve the model. Another challenge also stems from the CO_2e emission data. The current calculation model primarily employs CO_2e emission data from 2011, as this is the most recent available data from the EXIOBASE hybrid database. This may result in an overestimation of environmental impacts, particularly for those industries that have experienced substantial changes in their emissions profile since 2011.

In addition, to continuously improve its methods for monitoring carbon footprints, Denmark has a wide range of initiatives that aim to reduce emissions.

4.5 Malaysia

Malaysia's GPP policy framework has been rooted in the National Green Technology Policy since 2009 and has been reinforced in subsequent national development plans (SWITCH-Asia & UNEP, 2020). The Eleventh Malaysian Plan (2016–2020) aimed to make GPP mandatory for all government ministries and agencies, with a target of making 20% of government procurement green by 2020 (Government of Malaysia, 2016a). In support of its goals, Malaysia has made it mandatory for all 25 government ministries and agencies to implement GPP practices. Each ministry or agency is required to designate a GPP focal point and submit annual GPP implementation plans (GIZ, 2022).

To monitor the implementation of GPP, since 2014, the government has been tracking procurement expenditures for product and service categories that are prioritized in the GPP Long-Term Action Plan 2016–2030 (Government of Malaysia, 2016b; SWITCH-Asia, 2020). For sustainable products and services, actual purchases are considered, while for works, the focus is on the actual contract value and number of green products used. To qualify as green, products and services must adhere to the GPP criteria established by the government, which are aligned with various national and international ecolabelling schemes but adapted to ensure adequate product availability (SWITCH-Asia & UNEP, 2020).

The data for monitoring is collected annually through a spreadsheet by the Ministry of Energy, Science, Technology, Environment & Climate Change (specifically by the Malaysian Green Technology and Climate Change Corporation [MGTC], formerly known as GreenTech Malaysia). The data collected includes information on each procurement, including the product category, budget, tender announcement period, green criteria, procurement process details, final results, and total cost (GIZ, 2022). However, as the number of participating ministries and agencies increases, the Ministry of Finance is upgrading its e-procurement system to streamline GPP data collection and tracking (SWITCH-Asia & UNEP, 2020). In relation to green purchases, since 2016, the MGTC has been estimating the environmental benefits linked to the purchases (see Box 5). According to the latest guidelines on Malaysia's green procurement, the monitoring and reporting processes will focus on 40 specified groups of products and services, such as ICT, stationery, and electrical equipment, among others. Reports on the implementation of GPP will be submitted biannually to the Ministry of Finance and the MGTC, specifically every June and December. The reporting process utilizes the GPP reporting format provided by the Ministry of Finance. The GPP implementation reports from each ministry and their respective agencies will be analyzed by the MGTC to assess their GPP accomplishments and the total CO_2 emission reductions achieved. These findings will then be presented at the GPP Steering Committee Meeting (MGTC, 2021).

Box 5. Sustainability impact calculation of GPP in Malaysia

In estimating the environmental benefits of GPP, the MGTC estimated the benefits from seven energy-related product categories based on increased renewable energy use (for solar and mini-hydro energy) and improved energy efficiency (for ICT equipment, imaging equipment, street lighting, indoor lighting, air conditioning systems, fans, and televisions). For each product, specific environmental characteristics of the purchased green product must be entered into a spreadsheet provided by the MGTC to calculate the environmental benefit compared to an average non-green conventional product, which serves as the baseline (SWITCH-Asia & UNEP, 2020). The calculation formula is the following:

> *Environmental benefit in terms of GHG emission savings = Total number of products purchased during the year × (Conventional product environmental parameters − Green product environmental parameters) × Conversion factors of the green characteristics to CO_2e emissions.*

In 2018, reportedly a total amount of MYR 904.4 million was spent on GPP, and environmental benefit in terms of CO_2e emissions reduction reached 1,031.3 tonnes.

The following example (Table 5) illustrates the calculation of impact reduction achieved with green purchases for indoor lighting sources in 2017. The annual energy savings are calculated by multiplying the number of units by the difference in power between the green and non-energy-efficient light sources and then by the time of use. This results in a total energy savings of 12,895 kWh per year. The reduction in CO_2e emissions is then calculated by multiplying the energy savings by the emissions factor, resulting in an annual reduction of 8,949 tonnes of CO_2e.

Table 5. Example of the calculation of impact reduction obtained with green purchases for indoor lighting sources in 2017

Total number of products purchased	184 units
Power of the green light source purchased	28 W
Power of the non-energy-efficient light source	44 W
Time of use per year (12 hours/day)	4,380 hours/year
Electricity cost	MYR 0.365/kWh
Electricity emissions factor	0.694 kg CO_2e/kWh
	184 × (44-28) × 4,380 = 12,895 kWh/year saved
Impact reduction obtained with the green purchases	**12,895 × 0.694= 8,949 Tonnes CO_2e/year saved**

Source: Adapted from SWITCH-Asia & UNEP, 2020.

4.6 The Netherlands: Using the CO_2PL in assessing CO_2 emissions in both suppliers and procuring authorities

The Netherlands has had several policies and a legal framework dedicated to SPP/GPP since 2007 (UNEP, 2019). The country also has a national plan delineating its approaches to public procurement. The Dutch National Action Plan 2021–2025 outlines initiatives to enhance SPP adoption, including financing, coordination of international efforts, and improved support mechanisms for procurement officials (Nilsson Lewis & Machlowska, 2022). Since 2007, the Netherlands has also regularly monitored SPP implementation, in order to assess the achievement of the established SPP objectives for all public authorities nationwide (UNEP, 2019).

In the Netherlands, the governance of GPP is a collaborative effort involving several government bodies. The Ministry of Infrastructure and Water Management takes the lead in developing GPP policies and setting a precedent through leadership-by-example initiatives. Complementing this role, PIANOo, the Dutch public procurement expertise centre, offers information on sustainable procurement (Hasanbeigi et al., 2019).

To assist procurement officers in assessing their environmental impact, the Dutch government offers a range of resources and tools (Nilsson Lewis & Machlowska, 2022). A dedicated database provides easy access to SPP criteria, enabling the swift selection of relevant GPP criteria for a variety of products. Notably, the procuring authorities helped to co-develop tools such as the CO_2PL and DuboCalc. The CO_2PL is a CO_2 management system and a GPP tool created by the Dutch railway manager ProRail. It is now owned and managed by the SKAO, an independent and non-profit organization (for a more detailed explanation of the tool, see Box 1). Given that it was designed for use in procurement processes, the CO_2PL has been and is still used extensively in the Netherlands. The tool harnesses the power of procurement to integrate structural carbon reduction measures within organizations and their supply chains (Schep et al., 2023)

During the procurement process, CO_2PL certification is voluntary when suppliers submit bids for public contracts. Should the suppliers choose to pursue qualification under the optional award criterion, they have the flexibility to showcase their compliance with CO_2PL requirements at either the organizational or the project level. Additionally, SKAO recommends that suppliers are not required to have the proposed ambition level at the bidding stage. Instead, should a supplier win the contract using the CO_2PL, the proposed ambition level ought to be integrated as a performance clause in the contract, which the company is required to fulfill within 1 year of the start of the contract (Bechauf et al., 2022).

The CO_2PL is finding adoption beyond private corporations by expanding to public utilities and administrative bodies within the Netherlands (Bechauf et al., 2022). The CO_2PL helps public organizations to step up as environmental role models by aligning their practices with their carbon reduction targets and expanding their understanding of Scopes 1, 2, and 3 emissions (Bechauf et al., 2022). A recent development is the increasing number of contracting authorities obtaining certifications for their organizations under the CO_2PL, in the context of "practice what you preach." For instance, the Dutch Ministry of Infrastructure and Water Management is certified at level 5, and all Dutch ministries have attained certifications at level 3 or above (SKAO, n.d.).

In the case of monitoring, the CO_2PL could help monitor GPP in two main ways.

1. **Through the tendering process:** When used in a tender, the CO_2PL serves as a criterion for evaluating the environmental performance of bidding contractors. Contractors who achieve a certain level on the CO_2PL provide evidence in their project files. The project file offers insight into a project's emissions and the CO_2 reduction strategies a contractor employs within the project. The awarding party then reviews this project file, which could contribute to their monitoring of Scope 3 emissions. Such review by the awarding party ensures transparency regarding the contractor's supply chain emissions, an essential aspect of GPP monitoring.
2. **Procuring authority certification:** By obtaining CO_2PL certification themselves, procuring authorities can lead by example, demonstrating their commitment to CO_2 reductions in their operations. This certification process requires implementing all the necessary requirements of the CO_2PL related to Scopes 1 and 2 and, at higher levels, Scope 3, which would include their procurement activities. For example, the Dutch Ministry of Infrastructure and Water Management holds the highest level of the certificate (level 5). As a client for infrastructure projects, the ministry utilizes CO_2PL in their procurement process, where they give an award advantage to contractors certified in accordance with the CO_2PL, which enables them to gain insights into the carbon emissions associated with their procurement activities (Scope 3).

The adoption of CO_2PL has resulted in numerous benefits. Schep et al. (2022) discovered that within Dutch municipalities, the implementation of the CO_2PL has made information about CO_2 emissions and measures to reduce them more easily accessible compared to the period prior to certification. In terms of its impact on CO_2 reduction, several studies have been conducted to evaluate the impact of the CO_2PL. Rietbergen (2015) highlighted the role of the CO_2PL in enhancing energy management practices in construction and civil engineering, estimating an annual CO_2 reduction of up to 1.5%. Furthermore, in the water construction sector, there was evidence of a significant 7.8% yearly decrease in CO_2 footprints for a majority of companies (Rietbergen et al., 2017).

In 2022, CE Delft conducted a study on the implementation of the CO_2PL in Dutch municipalities (Schep et al., 2022). The study demonstrated that there was a 23.9% reduction in CO_2 emissions from 2018 to 2020, largely in Scope 1 emissions, where many municipalities experienced a substantial drop in CO_2 emissions either in the year they were certified or the following year. CE Delft also conducted a study that evaluated the effectiveness of the CO_2PL in reducing CO_2 emissions for certificate holders, both at companies and in the supply chain (Breman et al., 2023). Their study found that the CO_2PL is an effective instrument for helping companies reduce their Scope 1 and 2 emissions. A majority of companies have observed a reduction in their Scope 1 and 2 emissions by 20%–40% since obtaining their first year of certification. On average, this equates to a yearly reduction of approximately 7.7%.

5.0 Conclusion and Recommendations

This report identified the why and how to monitor the progress and outcomes of GPP. While there is increasing demand for evidence of GPP's effectiveness, actual practices quantifying its impact remain limited. These measurable outcomes are vital within the broader context of advancing environmental goals and using public procurement as an instrument to do so.

In particular, monitoring the impact of GHG or CO_2 emissions from public procurement is instrumental in countries evaluating their progress toward achieving climate goals. However, the scope of monitoring should extend beyond just CO_2 emissions. Other environmental and social benefits, such as biodiversity conservation, health, and gender equality, are also integral components. When procurement is utilized strategically, it offers the potential to monitor and positively influence a wide range of environmental, economic, and social outcomes.

Observations from case studies across South Korea, Japan, Slovenia, Denmark, Malaysia, and the Netherlands reveal several key patterns contributing to successful GPP monitoring impacts, including strong governmental support and legal framework, effective collaboration, and the provision of tools and resources. These countries have shown a commitment to GPP by enacting supportive policies, strategic plans, and legal frameworks and monitoring progress. A significant aspect of these frameworks is mandatory implementation and monitoring requirements for government ministries and agencies, as observed in most countries. Collaboration among various agencies/parties and the provision of tools and resources for procurement officers are crucial. For instance, most of these countries have implemented e-procurement platforms or other dedicated platforms, which record information on purchased products or services and simplify the process of measuring the benefits of GPP. However, challenges arise in both the literature and the case studies. The most commonly noted is the lack of comprehensive and transparent data, which presents a significant hurdle in accurately monitoring and evaluating GPP outcomes. Moreover, the complexity of GPP monitoring necessitates specialized knowledge and skills, a challenge evident in Slovenia's difficulties in effectively applying LCA and similar tools. Furthermore, monitoring the impacts of GPP is more of a focus at the product level and less so at the sectoral level. This shows that there is a gap in monitoring the impacts of GPP in, for example, high-emitting sectors, such as infrastructure, transportation, defence, and waste management. These are critical areas where significant emissions and potential savings are often concentrated.

The following recommendations are offered to governments seeking to initiate or enhance their GPP monitoring efforts:

1. **Define clear objectives and targets.** Establishing clear objectives is a pivotal step in GPP monitoring. Defining specific, measurable targets and goals provides a strategic direction for procurement activities and sets a standard for assessing progress. These objectives should be ambitious yet attainable, providing a clear framework for all stakeholders involved in the procurement process. Furthermore, sector prioritization for monitoring is also important. Identifying and focusing on sectors with the highest emissions intensity can significantly enhance the overall impact of GPP initiatives, as targeted efforts in high-emission areas often yield the most substantial environmental benefits.

2. **Establish a legal and policy framework that mandates monitoring and establishes roles and responsibilities.** A strong legal and policy framework is essential for the effective monitoring of GPP. Furthermore, making it mandatory for agencies to implement and report their GPP activities and results can ensure that public procurement activities are aligned with sustainability goals. Such a framework not only reinforces accountability but also establishes clear standards and procedures that can be uniformly applied across various levels of government. This will provide a solid foundation for tracking progress, identifying areas for improvement, and ensuring that procurement practices contribute positively to the broader environmental objectives of the country.
3. **Foster effective collaboration.** Effective collaboration among various governmental bodies is a key component in the successful monitoring of GPP. This collaboration should extend beyond just setting GPP targets; it needs to encompass the entire process, from data collection to the assessment of GPP's benefits. For instance, government bodies that set GPP targets should work closely with those responsible for monitoring to ensure that data collection is consistent, comprehensive, and aligned with the set targets. Additionally, agencies tasked with the measurement of GPP benefits should collaborate with data-gathering entities to ensure that the information collected is accurate and relevant. Such interdepartmental/interministerial coordination is vital to developing an efficient GPP monitoring system.
4. **Strengthen data management and control.** Countries should prioritize improving GPP data management systems. This involves setting up standardized processes for data collection, which are consistent across different levels of government and procurement entities. Ensuring compatibility between tools employed, such as organizational-level and product-level tools, is also important, as it would necessitate a harmonization of the methodologies used in calculating emissions and assessing environmental impact, which could help further standardize data collected. Such standardization ensures that the data collected is uniform, making it easier to analyze and compare. Additionally, adopting e-procurement systems with built-in GPP monitoring functionalities could reduce the administrative burden and improve the efficiency and accuracy of tracking GPP outcomes. It is also crucial to set up mechanisms for control to ensure the reliability and correctness of data.
5. **Provide resources, training, and capacity building.** Investing in training programs and capacity building is essential for personnel engaged in GPP monitoring. This investment is crucial for equipping staff with the necessary skills and knowledge to effectively utilize complex tools and methodologies integral to GPP. Furthermore, dedicated resources, including both human and technical, should be allocated to ensure that the personnel have continuous support and access to the latest tools and information.
6. **Promote effective communication.** Effective communication among stakeholders is crucial for enhancing efforts to monitor the impact of GPP. This includes identifying which contracting authorities and sectors are lagging in both monitoring and adopting GPP, providing them with targeted support and sharing best practices. Also, actively disseminating information about which strategies are less effective can improve GPP monitoring practices.

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