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## Promoting Sustainability through E-Vehicle Procurement: Experiences from Three Continents

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### ABSTRACT

Public and private entities face increasing demands to reduce the environmental impacts of mobility. A prominent strategy for meeting these demands is replacing internal combustion engine vehicles with electric vehicles (e-vehicles) in municipality and corporate fleets. Despite its potential, (sustainable) e-vehicle procurement remains an underutilised means of promoting sustainability in mobility. Some of the hurdles relate to lack of knowledge, insufficient commitment from organisations, and the perceived conflict between costs and sustainability. Despite these well-known challenges, a detailed understanding of the global e-vehicle procurement processes and the potential pitfalls and best practices that enable successful procurement is lacking. These limitations impede our understanding of how procurement practices vary globally and hinder future efforts to bring sustainable procurement to the forefront as a worldwide means of tackling global sustainability issues related to mobility, particularly the electrification of transport. To address this shortcoming, we conducted a qualitative case study on e-vehicle procurement drawing on interviews and qualitative survey data of procurers involved in a project aiming to promote urban electric mobility in Asia, Europe, and Latin America. Based on the responses, there are differences in existing regulations and guidelines governing procurements, as well as in the level of e-vehicle maturity, which affects how procurements are carried out. We recommend that procurers find a balance between flexibility and sufficient detail when formulating procurement criteria for successful context-specific solutions, utilize the domain expertise of providers to overcome lack of experience and clarify responsibilities and consolidate differing procedures in joint procurements.

### Open Access

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**KEYWORDS:** procurement; sustainable mobility; e-vehicle

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### ABBREVIATIONS

e-vehicle, electric vehicle; ICE, internal combustion engine; NGO, non-governmental organisation

## INTRODUCTION

Mobility and transportation play a crucial role in contemporary societies, but also contribute to various negative impacts that threaten the sustainability of communities. Notably, these systems account for 23% of global CO<sub>2</sub> emissions and create local environmental issues in many areas [1]. As an example, many metropolises across the globe experience poor air quality due to transport emissions, leading to health issues among people and harm to local ecosystems [2]. To address these problems, both public and private entities face increasing pressure to mitigate the environmental and other sustainability concerns associated with mobility and transportation. Especially in urban areas, transportation is being renewed to reduce resource use and improve livability [3].

A prominent approach to meeting the demands and mitigating negative externalities of mobility is sustainable procurement [4–6]. By considering and evaluating the sustainability impacts of mobility solutions, incorporating corresponding criteria into procurement processes, and favouring innovative solutions that align with sustainability goals, sustainable procurement can significantly contribute to reducing the negative externalities of mobility [7–10]. Beyond its direct effects, sustainable procurement acts as a catalyst for market direction, fostering innovation, development, and uptake of environmentally friendly mobility solutions that also contribute to social and economic sustainability [11].

One of the major advances contributing to sustainable mobility and which is bolstered by procurement practices is transport electrification. Due to its reducing effects on greenhouse gas emissions and local pollution, electrification stands out as a central endeavour in creating sustainable mobility systems. Thus, private and public organisations have grown increasingly interested in replacing existing internal combustion engine (ICE) vehicles with novel types of e-vehicles [12], as evidenced, for example, by the way public transport operators in many cities have implemented plans to electrify their fleets [12,13].

However, in the global context, procurement remains an underutilised means of promoting sustainability in mobility and transportation sectors. Prior research has identified several hurdles hindering sustainable procurement, including lack of knowledge, insufficient commitment within organisations, and a perceived conflict between costs and sustainability [6]. Exacerbating these well-known problems is that there is no detailed understanding of sustainable procurement processes specific to transport electrification, including the potential pitfalls and best practices for successful procurement in the domain. Moreover, within the broader domain of sustainable procurement, most of the existing research has been conducted in Europe and North America [6,14], leaving a knowledge gap on procurement practices in the emerging economies of the Global South [8]. These limitations impede our understanding of how procurement practices vary globally and hinder future efforts to bring

sustainable procurement to the forefront as a worldwide means of tackling global sustainability issues in mobility, particularly in relation to the electrification of transport.

To address the shortcomings of the extant corpus, we conducted a qualitative study focused on promoting sustainability through e-vehicle procurement. More specifically, we address the topic through the following research questions:

What are the key commonalities in managing e-vehicle procurements globally?

How do e-vehicle procurements differ across the globe?

First, we establish a foundation of sustainable procurement based on the existing research. Second, we provide insights from interviews and qualitative survey responses of procurers involved in the EU SOLUTIONSplus project, which aims to promote urban electric mobility in Europe, Asia, Africa, and Latin America. Based on the responses, we elaborate on the various procurement practices and procurer experiences in cities across the globe, identifying potential challenges, pitfalls, and best practices in sustainable procurement, with a specific focus on electric transportation. Finally, we provide guidelines for promoting sustainability through procurement.

## **SUSTAINABLE PROCUREMENT**

Procurement practices have emerged as a vital tool in addressing sustainability issues in the mobility and transport sectors, and the role of the purchasing organisation, in contrast to the providing one, has become increasingly prevalent in discourses around sustainability [15]. The overlapping terms ‘green procurement’, ‘sustainable procurement’, and ‘circular procurement’ refer to integrating environmental or other sustainability criteria into the procurement of products and services, with these criteria being used to evaluate bids and award contracts [16]. Additionally, an approach to sustainable procurement includes the procurement of novel or innovative sustainable products and services, such as novel types of mobility devices [9,10]. Accordingly, sustainable procurement can have a direct impact on the negative externalities associated with transportation, but it also serves as a market trigger encouraging the development and adoption of novel sustainable solutions that serve the public interest [17]. In particular, the role of public procurement as a catalyst towards more sustainable markets has been acknowledged, and for example in the EU, public authorities are required to include sustainability criteria into procurement criteria [5,7,9,12].

In the transportation context, procurement plays a key role in replacing fossil-fuelled vehicles with e-vehicles in the drive to reduce greenhouse gas emissions and pollution [5]. In many areas, the overall adoption of e-vehicles is hindered by issues such as insufficient knowledge, high prices, and a lack of positive societal signals encouraging the acquisition and use of e-vehicles [18]. It has been argued that particularly public organisations

have a pivotal role in supporting local market development to encourage wider uptake of e-vehicles through procurement practices that favour transport electrification, while also private organisations can assume the forerunner role in their uptake [11,19]. Support for this argument exists in the literature, which indicates that localised demonstration projects involving the introduction of e-vehicles in the public sector can contribute to the purchases of similar vehicles by individuals [20].

### **Barriers Hindering Sustainable Procurement and Means to Overcome Them**

Despite the positive impacts, public authorities and private organisations face problems implementing sustainable procurement. These difficulties can stem from sources external to the procuring organisation, such as public procurement legislation and policies, as well as national standards, templates, and guidance for sustainable procurement [21,22]. Some of the difficulties, however, are endogenous to the procuring organisation, and prior research indicates that sustainable procurement faces problems such as lack of environmental knowledge and awareness, hindrances related to organisational goals and structure, and financial issues [21]. Especially in smaller organisations, dedicated purchasing departments, environmental experts, and sufficient resources to develop and establish procurement strategies might be lacking, hindering sustainable procurement [22]. In the case of e-vehicle procurements, prior research has noted that while procurers often have knowledge of the existing regulations and legislation, they might lack sufficient technological expertise and awareness related to e-vehicles [11,23]. Moreover, the tools and processes related to sustainable procurement are often absent, leading to costly and time-consuming procurement processes, insufficient ex-ante assessments and incoherent evaluation of the goods or services being purchased, and settling for 'good enough' solutions [5,24].

The literature has identified several factors that can help overcome obstacles related to sustainable procurement. In their review, [8] classify these factors into three categories: organisational aspects, individual behaviour, and operational tools used in procurement. Among the organisational factors, it is pivotal that organisational structures enable the efficient flow of information. The sustainable procurement goals and objectives should be integrated into the organisation's strategies and the planning and goal setting implemented by managers to encourage sustainable procurement [8]. Electric vehicle procurements differ from ICE vehicle procurements in that the processes are less standardised and thus more likely to be directly impacted by top management [19]. Cooperation between procuring organisations can facilitate implementing sustainable procurement practices, especially in the case of small organisations that lack the resources on their own; this is especially true of e-vehicle procurement, where technological expertise can be a

challenge to the procuring organisation [11,22]. Among individual factors, agency, individual beliefs, and behaviours have an influence on sustainable procurement. These factors can be shifted by hiring employees who understand the benefits of sustainable procurement, and who can serve as agents of change and encourage development throughout the organisation. Providing adequate training, education, and guidance has a positive impact on both employees' beliefs and knowledge of sustainable procurement. The factors related to operational tools include the implementation of process and prioritisation tools, calculation and criteria setting tools, standards, and supplier selection tools that allow the systematisation of sustainable procurement processes and provide support for decision-making [8].

Consistent with the findings of [7,8] found, in their study of strategic motivations for using public procurement, that key factors influencing sustainable procurement relate to strategies and goals supporting sustainability, effective implementation of suitable sustainability requirements in the procurement (functional or specific, award criteria used), understanding how the costs are incurred in green procurement, the size of the procuring organisation (bigger ones usually have more resources and established processes for sustainable procurement), and the available information, knowledge, tools and practices supporting the procurement process (e.g., information exchange with suppliers, training, existing guidelines).

Additionally, prior research has identified practices that facilitate the use of sustainable procurement as a tool fostering innovation, and which serve long-term sustainability goals rather than settling for promoting short-term reactive solutions with conventional technologies [25,26]. In their study, [27] highlight the importance of establishing a dialogue with suppliers before inviting final tenders. This competitive dialogue allows the mapping of procurer needs and of potential solutions that the supplier can offer to meet these needs, creating room for innovative approaches that might otherwise fall outside the tendering scope [27]. Besides the procurer-supplier dialogue, prior research has argued for involving the end-user in the procurement process to develop innovative solutions that meet their needs [28]. Overall, procurement can create incentives for sustainable innovation through interactive governance, while the domain still lacks inquiries into how this is best actualised [29].

## **METHODOLOGY**

### **The Case Study Setting**

Our methodology is based on a tradition of qualitative case study research [30] and focuses on e-vehicle procurements in several cities across Latin America, Asia, and Europe, each of which has a unique set of needs and challenges when it comes to mobility. In the context of the SOLUTIONSplus project (2020–2024) funded by the European Union's

Horizon 2020 research and innovation programme, e-vehicle demonstrations have been implemented on four continents (African locations were excluded from this study due to delayed procurements). Their aim has been to assist policymakers, local institutions, and other stakeholders in adopting innovative mobility solutions that serve both local and global sustainability goals. A core goal has been to identify the factors that affect the successful implementation of novel and more sustainable electric transport solutions in various geographical, infrastructural, cultural, and institutional contexts.

One of the enablers of sustainable transport solutions, and our main interest in the demonstrations, is the procurement of different public and commercial e-vehicles. Table 1 shows the seven city demonstrations we selected for our analysis. At each location, the implemented e-vehicle solutions were tailored to the specific requirements and goals of the city, while accounting for the contextual factors and constraints that affect the uptake of e-vehicles.

**Table 1.** The demonstration cities.

City	Main procuring organization(s)	Procured vehicles or services
Hanoi (Vietnam)	University	Electric 2-wheelers
Pasig (Philippines)	Non-governmental organization	Locally developed E-quadracycle and flexible electric van, FLEV for passengers and cargo
Kathmandu (Nepal)	Public transport organization	Conversion kit for diesel to e-bus
Quito (Ecuador)	Municipal environmental fund	E-cargo bikes
Montevideo (Uruguay)	Municipality	E-buses for the municipal fleet
Hamburg (Germany)	Public transport operator	Shared e-scooter service
Madrid (Spain) <sup>1</sup>	Public transport organization	E-buses for the municipal fleet

<sup>1</sup> Municipality of Montevideo and EMT Madrid were not involved in the procurement of vehicles but of vehicle charging systems under the scope of SOLUTIONSplus. Their responses in procuring e-buses are based on their previous experience.

## Materials

Stakeholders involved in the procurements associated with the case studies took part in the study during April–May 2023. The data was collected through an open-ended survey (see Appendix: survey questions) designed to capture the respondents' experiences with the procurement process during the SOLUTIONSplus project. According to the national guidelines on research integrity, no ethical review was necessary for a

survey and interview study. The survey questions covered five topics: (1) Strategies and goals related to public procurements, (2) requirements for public procurements, (3) costs related to public procurements, (4) actors in the procurement process, and (5) knowledge and information.

The survey was distributed to the respondents by email, offering them the choice to complete it independently and email their responses to the researchers or to be interviewed using the same set of questions as in the survey. The survey respondents were identified with the help of the SOLUTIONSplus demonstration city coordinators, who contacted them directly or provided the contact details of relevant local persons involved in the procurement processes. Altogether seven responses from seven procuring organisations (see Table 1) were received; five participants provided written survey responses and two were interviewed. The responses were supplemented with additional email exchanges with representatives of the pilot cities and SOLUTIONSPlus demonstration city coordinators as well as documentary materials from the demonstration locations.

### **Analysis**

The analysis of the survey data was based on a directed approach of qualitative content analysis, where previous research guides the initial thematic coding and analysis [31]. The analysis began by taking the key barriers identified from the literature as initial coding categories, but it was soon realised that the categorisation needed adjustment as these alone were not sufficient in capturing the results. Therefore, the categorization into factors related to strategy, costs, size, and knowledge & information used by [7] was assumed and additional categories were formed to capture the results in a more nuanced way. Overall, the categorisation was therefore elaborated iteratively throughout the analysis ending up to six categories, which describe the topics on which we found evidence in the survey responses and interviews. The analysis was conducted independently by two researchers and the formulation of categories and respective codes were discussed throughout the process.

### **RESULTS**

Our findings indicate that the experiences and procurement practices, as reported by the respondents, vary across cities, while certain commonalities and recurring patterns could be observed. To delve into the procurer experiences and existing practices, the findings are categorised into six key areas: (1) Strategies and goals; (2) procurement regulation and guidelines; (3) procurement processes and practices; (4) procurement criteria, evaluation and selection; (5) collaboration and information exchange; and (6) knowledge and competence.

These categories were recognised from the survey data as key topics in managing e-vehicle procurements, and they are in line with but expanded from the significant factors of sustainable procurement identified by [7].

Additionally, we provide a more granular analysis of the findings based on the thematic and local patterns across three continents that were observed when analysing the interview and survey responses. Specifically, the findings related to the procurement setting include the processes for setting requirements, as well as the specific requirements and criteria resulting from these processes. Similarly, the findings pertaining to knowledge and information are described in terms of the competence and knowledge of procurers, as well as the exchange of information between the involved stakeholders.

### **Strategies and Goals**

All the respondents acknowledged the existence of sustainability goals, strategies, or plans that aligned with and guided the procurement activities throughout the project. These strategies and goals focused primarily on the global and local environmental issues related to mobility, i.e., climate action and emission reduction, and reducing reliance on fossil fuels. However, some respondents also raised significant social and economic sustainability objectives, such as stimulating the local economy through domestic purchases.

Although sustainability strategies, goals, and plans were brought up by all the respondents, their extent and breadth varied substantially. Some perceived that procurement efforts were guided by global sustainability goals, such as those outlined in the Paris Agreement, while others mentioned plans and objectives specific to their respective cities and neighbourhoods or even guided mainly by organisational sustainability goals. Some of the goals were rather ambitious and aimed for a high local impact. For example, in Quito, there was a goal to transform the historic centre into a zero-emissions zone free of ICE vehicles.

*“At a global level, the procurement is in line with the Paris Agreement, the Sustainable Development Goals, and the C40’s Green & Healthy Streets Accelerator. The procurement is aligned with Quito’s Metropolitan Plan for Development and Territorial Planning, the city’s Climate Action Plan, and the Sustainable Mobility Plan for the City. Specific to the promotion of a Zero Emissions Historic Centre” (Quito).*

*“The project followed the company’s procurement process criteria and the general/overall sustainability objectives. There isn’t a direct connection to goals or strategy of the city of Hamburg. Sustainability and to change mobility for good were the key ideas behind the project” (Hamburg).*

### **Procurement Regulation and Guidelines**

While strategies and goals were widely acknowledged, there were differences in whether these were operationalized in regulations and guidelines that governed the procurements. Specific regulations and guidelines governing the procurement processes were highlighted by three of the seven respondents. These regulations and guidelines were established by national, local, or organisational authorities and varied

depending on the sustainability aspects of procurement they emphasised. For example, the Quito respondent mentioned that the procurement conducted in the city followed regulations instantiated by local and national authorities which had differing goals regarding the procurement. First, the procurement adhered to the guidelines of a municipal institution whose main purpose is to prevent corruption in procurement, making procurement processes more transparent. In addition, the procurement followed the regulations of the National Public Procurement Service, as well as the Ordinance on the non-waste of resources, which promote sustainable purchases that socially, economically, and environmentally responsible. In the two European cases, procurements were mainly guided by organisational regulations instead of those instantiated by national or regional authorities; according to the public transport operator respondents from Hamburg and Madrid, the procuring organisations expect procurements to be transparent and to follow detailed rules instantiated within the organisation.

However, other respondents did not acknowledge any regulations or guidelines that promote sustainability in procurement. Despite the lack of formal guidelines, they perceived that there was still a consensus among procuring authorities, possibly stemming from the overarching sustainability goals and strategies, to favour environmentally sustainable options, as well as flexibility in allowing consideration of sustainability aspects of the procurement process:

*“As far as I know, no formal guidelines or procedures aside from the general consensus to shift from combustion engine powered vehicles” (Pasig).*

*“As far as we know, there is no specific policy on promoting greenness in procurement. However, in the general legal provisions, there is still openness to the prioritised contents when making procurement, such as priority for domestically produced goods, goods/technologies with environmental protection” (Hanoi).*

Generally, while existing regulation and guidelines were seen to promote transparency, in some cases they were considered restrictive, and the respondents appreciated having flexibility in the procurement process. The regulatory leeway enabled quicker and more fluent procurement, as did establishing dialogue with potential providers early on in the process to map out insights on possible solutions. This aspect was highlighted by the respondent from Quito, where procurement was conducted through a process of competitive funds involving a co-financing mechanism between public and private funds launched by the municipal environmental fund. The competitive fund process was subject to less stringent regulations than public procurements generally, which provided an opportunity for dialogue with the providers:

*“Bureaucracy [was a challenge] in the process for the development and follow-up of the implementation of the project. The Environmental Fund must comply with the regulations established in the Guide for the*

*administration of agreements in the Municipality of Quito that can be very rigid and restrictive.*

*“A Competitive Fund process is better than a traditional public procurement process, because it provides greater openness to dialogue with the manufacturer to make changes to the design, vehicle components, and in general adjusts to the reality of the manufacturer and the financier’s needs without imposing difficult and bureaucratic procedures from public purchases” (Quito).*

### **Procurement Processes and Practices**

While existing regulation and guidelines generally set boundaries for procurement processes, in several cases their inherent flexibility allowed procurers to use their judgement on how the processes were finally carried out and what type of practices were used.

Three of the respondents highlighted the importance of planning and setting the direction early in the process for eventually enabling a successful procurement:

*“It is important to have clear procedures from the beginning of the project, which includes the evaluation of proposals and the further development of the project. We recommend establishing processes and formats in which the parameters for sending relevant information such as budget execution and technical reports are specified to avoid errors in the documentation and save time in the delivery of resources” (Quito).*

Planning the process was not considered either trivial or straightforward, and the importance of periodic check-ins to keep the process on track was highlighted by the Pasig respondent. Additional challenges arose in getting different parties within the procuring organisation involved:

*“As is often the case with such processes, it was initially a challenge to get all the internal relevant stakeholders involved. Moreover, it was not that easy to translate the results of the procurement process into concrete tasks for the different stakeholders. That took some time” (Hamburg).*

Although planning early on was seen as a critical stage, it was deemed important to maintain flexibility to alter and refine the plans at later stages of the procurement, particularly as the procurements were far from routine purchases in many cities and involved the acquisition of new types of technologies and creation of novel service models. As mentioned by the Hamburg respondent, striking a balance between early planning and having the flexibility to later utilise the expertise of suppliers was deemed important:

*“Our ideas had to be formulated precisely, although we still wanted to define some aspects together with the provider we are searching for” (Hamburg).*

Moreover, in some countries and locations, e-vehicle technologies in general are novel and less established, which created hindrances to the procurement process, for example due to unforeseen changes in market

prices. In Kathmandu, where the procurement considered the conversion of a diesel bus to a e-bus, the lack of potential supplier expertise was considered the main challenge throughout the procurement, as well as lengthening the process:

*“This project needs quite advanced tools in the context of Nepal, so very few parties apply for the procurement, and the chance of withdrawal is high, which increases the time of procurement. Attracting the vendor was the main challenge” (Kathmandu).*

A similar lack of local suppliers was observed in Quito, where e-cargo bicycles were procured. However, unlike in Kathmandu, the Quito respondent perceived that the relative lack of suppliers eventually made the procurement process less time-consuming:

*“It took less time because there were only two proposals, considering that the manufacture of e-vehicles is a very specific activity and that in Ecuador there is not much supply from local producers” (Quito).*

### **Procurement Criteria, Evaluation & Selection**

Requirement and criteria setting was seen as a critical stage in the procurement process, and most of the respondents emphasised that sufficient effort should be dedicated to successfully setting detailed requirements, as this would aid in the following stages of the procurement process:

*“The procurement document should be prepared with as much detail as possible so that the potential suppliers will be easier to follow and more easily meet the requirements” (Hanoi).*

*“Have a good description of what we are searching for, what our solutions should look like, and have good criteria on how to really ask the providers to come up with some solutions. This front loading was good to have” (Hamburg).*

In some of the cases, the procurers went beyond relying solely on the processes and knowledge within their organisation to set the requirements and selection criteria. An example of this was observed in Hamburg, where the procurers tapped into the domain expertise of potential service providers. They initially devised a comprehensive set of selection criteria jointly with innovation, procurement, sales, and safety departments. However, during the tender call stage of the procurement process, these criteria and requirements were discussed and refined collaboratively with the businesses that responded to their call. While giving the service providers space to affect how the developed service would turn out was deemed good practice, it also posed a challenge in terms of balancing the setting of specific requirements that address the procuring organisations' needs, and giving the service providers freedom to ideate innovative solutions:

*“One of the main challenges during the procurement process was—at the beginning—to describe our e-scooter service as concretely as possible without making any restrictions. Moreover, it was not that easy to translate*

*the results of the procurement process into concrete tasks for the different stakeholders. That took some time” (Hamburg).*

Technical tools supporting the procurements were seen as important for the evaluation and selection of the supplier. Two of the seven respondents (Kathmandu, Madrid) praised the use of a digital platform as a tool for facilitating the procurement process and storing the documents.

*“We used an E-bidding process to select the vendor for the conversion kit, which resulted in fair, competitive and quick selection. It [data collection and storage] can be done by collecting, storing, and maintaining using MIS (digitally)” (Kathmandu).*

Criteria related to the providers mainly focused on previous experience with similar commissions, as well as the capacity to comply with e.g., legal and administrative requirements associated with the project. Overall, all the considered procurements had a green/sustainability element in the procurement criteria.

### **Collaboration & Information Exchange**

In many of the cities, the procurement process involved tight collaboration between the different stakeholders involved. For example, in Hamburg it was carried out by a single organisation, but to exploit a wide range of internal expertise, different departments including innovation, sales, safety and procurement were involved in the e-scooter procurement. In several cases the procurement was carried out by representatives from multiple organisations. In Quito, for example, a committee comprising municipality representatives of the mobility secretariat, environmental secretariat, and the city council, in addition to representatives of the SOLUTIONSplus project, was formed to carry out the procurement.

Due to procurements being collaborative efforts in most of the case-study cities, many of the responses highlighted issues related to information exchange among stakeholders involved in the procurement process. Problems were particularly pronounced when multiple organisations were engaged in the procurement, as sharing information and reaching a consensus on procurement practices proved difficult. A clear example of this was seen in Pasig, where a non-governmental organisation (NGO) and city officials collaborated in the procurement process, the NGO being the responsible organisation. According to the Pasig respondent, the contrasting procurement practices between the NGO and the city resulted in misunderstandings and obstacles when it came to executing procurement line items. The city’s procurement regulations, being more stringent due to the use of public funds, differed from those of the NGO, which was not subject to the same regulations. The respondent mentioned that clearly defining the organisation in charge of the procurement would aid in avoiding such problems.

Besides communication among procurers, ensuring the efficient flow of information between procurers and suppliers was highlighted in many

of the responses. Notably, efficiently communicating the requirements and ensuring that suppliers comply with them was deemed challenging, while the means for tackling these issues included detailed procurement documentation and regular check-ups during the procurement. However, information exchange was not only perceived as a hurdle to overcome; in Hamburg, alongside co-ideation between the procuring organisation and the service provider, it was considered an important success factor throughout the process and deemed both fruitful and pleasurable by the respondent:

*“We had a lot of fun discussing all this stuff to get the best out of this procurement process for us and hope for this Solutions Plus project to have the best solution for us. With the results of today we have from the customer service and all the feelings from the customers on the street, I would say it was the right way, the right decision and this is of course a good feeling for us here in Hamburg” (Hamburg).*

This information exchange was helpful in identifying the implementation location, where the procuring organisation and service provider could gather to discuss their ideas regarding the novel service to be implemented. In the latter stages of the procurement, the two procurement process members arranged regular weekly meetings. Some of these meetings also took place in the project environment and focused on spatial issues to be resolved before implementation, such as parking spaces, traffic signs, and markings. These consistent information exchange and ideation meetings throughout the project were considered beneficial to the incremental service planning and development that finally led to a successful demonstration implementation:

*“When we had already decided for TIER, then for the first week we just had discussions and also met outside. We visited the stations. We discussed where we should position the physical parking zones. We had discussions at the end of every week. We came closer and closer to the final concept and then we could, for example, book more or fewer parking spaces, we could buy the parking signs and order the pavement markings. This was a step-by-step approach. Very good, very useful discussions. And it started right in the tender calls and ended up in many, many bilateral discussions with TIER, our provider” (Hamburg).*

A similar emphasis on the importance of dialogue between the procuring organisation and the provider was observed in Quito. According to the respondent, the public procurement processes that are normally followed do not allow sufficient dialogue of this kind. However, in the case study, the procurement was conducted through a competitive fund, allowing more flexibility to tailor the procured vehicles to what is convenient for the provider and procurer:

*“A Competitive Fund process is better than a traditional public procurement process, because it provides greater openness to dialogue with the manufacturer to make changes to the design, vehicle components, and in general adjusts to the reality of the manufacturer and the financier’s needs*

*without imposing difficult and bureaucratic procedures from public purchases” (Quito).*

Further, co-operation with operators and local and national government was seen as important in Montevideo. Deep involvement of both national and local government in the procurement process and interest from the operators’ side to promote electrification of the vehicle fleet were prerequisites for the collaboration.

### **Knowledge & Competence**

In addition to hurdles in information exchange, some of the respondents identified lack of knowledge and competencies of the procurers as a challenge to overcome. This lack of knowledge pertained to both sustainable procurement practices in general and technological expertise related to transport electrification. For example, the Montevideo respondent described e-vehicle technologies as ‘black boxes’ while emphasising the necessity of acquiring knowledge related to transport electrification for successful procurements. As domestic expertise was scarce, this expertise could be acquired through international collaboration and exchange of information. Further knowledge and competence on sustainable procurements was gained by attending courses organised internationally and by actively participating in research projects. An additional relevant aspect mentioned by the Hanoi respondent was that the knowledge of the individuals or unit preparing the procurement documents has an effect on the procurement criteria.

Further to the competences of the procuring organisation on how to manage the procurement process, also knowledge on the potential suppliers and their capabilities and competences was considered important for a successful procurement process.

*“Numbers of suppliers, capacity to supply, availability of quality product on the local market, reach of notice to the suitable suppliers, are some of the important data” (Kathmandu).*

In certain instances, the procurement process itself was viewed as a means of acquiring knowledge and enhancing the capabilities within the organisation. This was enabled by feedback mechanisms that provided the procurers with information about the feasibility and effectiveness of the eventual implementation of the service or product. Beyond its informational value, the feedback served as a source of motivation, enabling procurers to comprehend the tangible outcomes of the project. For instance, in Hamburg, the procuring organisation’s customer service department collected valuable insights from users, and the project garnered favourable media coverage, which was considered gratifying:

*“With the results of today we have from the customer service and all the feelings from the customers on the street, I would say it was the right way, the right decision and this is of course a good feeling for us here in Hamburg. We have generated many insights, lots of data, and this is also an advantage for us, with the public viewing on this project, which is very, very good. We*

*did a lot for the e-scooters to stay here in Hamburg. So, we are in close contact with the city of Hamburg with the authorities, with the different districts. And the media is writing in a good way” (Hamburg).*

## DISCUSSION

We conducted a qualitative study to examine sustainable mobility procurement practices globally, with a specific focus on e-vehicle procurements. To do so, we drew on interview and qualitative survey responses of procurers involved in a project aiming to promote urban electric mobility in Asia, Europe, and Latin America. By delving into the experiences of procurers from various geographical and cultural contexts, our study contributes to the existing body of research on e-vehicle procurement as well as sustainable procurement more broadly. Looking into procurements with similar characteristics carried out across different locations around the globe allowed us to explore the overarching similarities in procurement while uncovering some of the nuances that arise when implementing e-vehicle procurements in different parts of the world. Table 2 highlights some of the findings according to the six themes that were constructed based on the analysis.

**Table 2.** Summary of the main findings.

Theme	Main findings
Strategies and goals	Sustainability goals and strategies are widely recognized, yet their extent and breadth vary across locations.
Procurement regulation and guidelines	Local variations in the existence of regulation and guidelines. Regulations were seen to promote transparency, yet were also considered restrictive.
Procurement processes and practices	Flexibility in regulation allowed procurers to use varying processes. Preserving flexibility to refine plans and criteria later in the process was deemed important. Lack of local suppliers hindered the procurement process in some locations.
Procurement criteria, evaluation & selection	Formulating detailed criteria was deemed important. Collaborative requirement setting with suppliers aided in some of the procurements.
Collaboration and information exchange	Ensuring information exchange is crucial in joint procurements. Dialogue and co-ideation with suppliers throughout the process is a good practice.
Knowledge & competence	Utilizing supplier expertise enables overcoming lack of procurer knowledge on e-mobility.

To answer the first research question, ‘What are the key commonalities in managing e-vehicle procurements globally?’, we were able to identify commonalities across the responses from different demonstration cities, along with recurrent procurement characteristics that contribute to or hinder successful and fluent procurement activities. The most prevalent commonality that recurred across demonstration cities related to sustainability strategies and goals. In all the demonstration locations, the respondents acknowledged the existence of such strategies and goals that guided the procurements carried out. Prior research emphasises the importance of sustainability strategies and goals in the realisation of sustainable procurement, and their existence across the demonstration cities indicates that sustainability considerations have become established issues in urban mobility contexts globally [7]. Moreover, although comprising of heterogeneous areas with unique problems, the sustainability problems faced by cities in the Global South are more urgent and pressing than those of their counterparts in the Global North, mainly due to the implications of rapid and extensive urban growth [32]. The existence of ambitious sustainability goals and strategies in these regions, such as creating zero-emission areas, implies that pressing sustainability issues are leading to drastic efforts to improve the quality of life in many of the urban areas of the Global South.

In addition to uncovering commonalities, our study revealed several contextual differences in the procurement processes, addressing our second research question: ‘How do e-vehicle procurement practices differ across the globe?’. While all respondents acknowledged sustainability goals and strategies, notable variations emerged in how they were put into practice. One of the observed differences between the cities was the presence or absence of sustainable procurement regulations and guidelines. In certain cities, procurement activities were guided by regulations established by multiple authorities, each emphasising different aspects of sustainability. However, in other cities, the absence of regulations promoting sustainability in procurement was evident, resonating with prior research noting that sustainable procurement regulation is not established and developed in all parts of the world [33]. In such instances, the knowledge and perspective of the procurer became emphasised, as they had the freedom to address sustainability issues based on their individual judgment and discretion. The lack of formal guidelines implies that sustainability considerations are addressed in a non-systematic manner. However, it is worth noting that governance deficiencies can create opportunities for innovative solutions and experimentation. This flexibility may give rise to organic developments that contribute to the sustainable development of urban areas. While formal regulations provide structure for procurement processes, the absence of rigid guidelines can foster an environment where creative approaches are explored [32]. This aspect was highlighted in some of the

responses, where rigid procedures to be followed were seen as a hindrance to establishing dialogue with the suppliers to foster innovation and find the optimal solution for the context, which was seen as an essential practice that enabled successful procurement in some cities. Flexibility of the process may also allow gaining information on the competence and capabilities of the suppliers, which can be crucial in carrying out a sustainable procurement process—finding also highlighted by prior research [7,8,34].

Nevertheless, in the post-COVID era, corruption has become more commonplace particularly within public sector procurement, and the issue could be heightened by the increased consultation with suppliers in the early stages of the procurement [35]. Thus, it is worth noting that, although they might make procurement processes more rigid, clear regulations and guidelines for accounting for sustainability play a crucial role in making procurement processes equal, preventing corruption, and increasing procurement transparency. Furthermore, the absence of procurement guidelines and regulations pertaining to sustainability poses a risk of sustainability goals and objective not translating into procurement praxis. In strong institutional and regulatory environments, regulation is a key driver for sustainable procurement practice [36]. Therefore, in the absence of regulation and guidelines, procurement might be carried out using standard criteria and processes instead of carefully and unequivocally matching procurement criteria with sustainability goals which has been highlighted as a crucial aspect to sustainable procurement effectiveness [37].

Besides procurement regulations and guidelines, the project cities differed their adoption of e-vehicle technologies, which affected how the procurement processes turned out. Resonating with prior research, our results indicate that transport electrification is still less established in some of the developing countries that face financial, infrastructural, and technological barriers to e-vehicle adoption [38]. As noted by prior research and confirmed by our findings, this lack of existing local markets hinders the availability of competent suppliers but also means that the procurers are less experienced with e-vehicle acquisitions and lack technological expertise in the domain [11]. In such cases, the procurers lacked the option to rely on provider expertise in developing solutions suitable to the application context, which was considered a critical success factor in other cities where e-vehicles had become more established. Means to overcome the lack of local expertise included acquiring the necessary competence through international collaboration, as well as forming bigger coalitions of organisations to collaborate on the procurement, a finding that resonates with prior research [11].

## Recommendations

Based on the results of our study and prior literature, we provide the following recommendations for e-vehicle procurers:

Finding a balance between flexibility and sufficient detail when formulating procurement criteria helps develop successful context-specific solutions. Based on the results, formulating detailed and clear procurement criteria is essential, as it will aid the suppliers in the bidding phase and improve the fluency of the remaining phases of the procurement. However, posing too many constraints may come at the cost of purchasing suboptimal solutions for the given context. E-vehicle technologies are advancing rapidly and are additionally often accompanied by novel service models, such as those based on sharing economy, which means that they are still less established in many regions and procurers often have only limited experience with them. Therefore, too many constraints on the solution might hinder exploitation of the provider's expertise in proposing a solution that is both suitable for the context and optimal given the current state of e-mobility technologies. Moreover, based on the results, establishing market dialogue and involving providers in the criteria formulation seems to be good practice, given that many e-vehicle technologies and service models have only recently emerged. This resonates with prior research encouraging collaborative discussion with bidders and competitive dialogue practices to foster innovative solutions [27,29,39]. Nevertheless, as noted by prior research, this should not come at the cost of formulating criteria according to industry standards but the criteria should clearly align with the overarching sustainability goals [37].

Utilising the domain expertise of providers throughout the procurement process helps in overcoming the lack of experience on transport electrification. As noted previously, procurers in many regions may still have limited experience with e-mobility due to the novelty of these technologies. Therefore, leveraging the expertise of the providers in the field is beneficial for the procuring organisations. This utilisation can be initiated early in the process to shape the procurement criteria in alignment with the current state of e-mobility technologies and services. Once a supplier has been chosen, maintaining this collaboration on an ongoing basis helps develop solutions that suit the specific context. As evidenced by our findings, engaging in dialogue and co-planning with the supplier within the operational context can be beneficial, particularly when the procurement involves more than simply swapping one fuel type for another. In cases where the goal is to establish a novel type of service that necessitates e.g., infrastructure changes, this in-situ collaborative approach proves beneficial. However, transparency and just procedures should be ensured when interacting with suppliers early in the process, and procurers should carefully consider matching the procurement criteria with sustainability goals that they are addressing without excess influence from the suppliers [35,37].

Clarifying responsibilities and consolidating differing procedures in joint procurement facilitate more fluent procurement processes. In many cases, mobility procurements are carried out collaboratively by two or more contracting entities, as was observed in some of the demonstration cities in this study. This approach offers benefits by allowing for the integration of expertise from multiple organisations, each with varying competencies in different aspects of transport electrification as well as procurement practices in general. Furthermore, joint procurement conducted through private organisations proves advantageous considering our findings, as private entities seem to have more mature and refined procurement processes and are not bound by the strict regulations typically faced by public organisations. However, it is important to note that our results indicate that joint procurement also presents challenges, primarily due to the differing procedures of private and public organisations. Clear procedures and defining responsibilities for joint procurements from the outset of the process are approaches that can aid in overcoming these challenges. By doing so, potential hurdles can be addressed early on, ensuring smoother collaboration and successful outcomes throughout the process.

#### **LIMITATIONS & FUTURE RESEARCH**

This study has two main limitations. First, the empirical base for this study consisted of a low number of survey and interview responses which affects the generalizability of the results. Although rich in detail, the responses might not represent a broader population, and give an unbalanced view of the procurements. Furthermore, due to the small sample size, it is likely that data saturation has not been reached and additional responses would have likely yielded more diverse information affecting the conclusions and recommendations of the study.

Second, the responses pertain to the context of a single EU-project whose aim was to increase the uptake of electric mobility in urban areas globally. This again might hinder the results generalizability. For example, procurers involved in the project may have been guided by specific practices, market conditions or strategies that are not representative of other urban areas or electric mobility initiatives. Therefore, the results may not directly reflect all aspects of the current opportunities and constraints in advancing e-mobility globally.

Accordingly, we suggest future research to examine the differences and commonalities in procurement practices across the globe using a more robust and comprehensive empirical basis. For example, gathering responses of various stakeholders involved in a single procurement can tease out a more nuanced understanding of the pitfalls and best practices that shape them. Furthermore, focusing on procurements that are not guided by projects advocating electric

mobility can reveal more diverse practices and perceptions governing procurement processes.

## **CONCLUSIONS**

This article reported a qualitative study on e-vehicle procurement, drawing on qualitative survey and interview responses of procurers involved in a project aiming to promote e-mobility in urban areas across the globe. Based on the responses, we were able to uncover similarities, including the existence of sustainability goals and strategies that guide procurement as well as differences, including those pertaining to procurement regulations and guidelines as well as the state of e-vehicle technology maturity in different locations that influenced the procurement processes. Based on the results and prior literature, we were able to provide three broad recommendations for e-vehicle procurers—finding a balance between flexibility and sufficient detail when formulating procurement criteria, utilizing the domain expertise of providers throughout the procurement process, and clarifying responsibilities and consolidating differing procedures in joint procurement.

## **DATA AVAILABILITY**

The dataset from the study is not available due to their containing information that could compromise the privacy of the research participants.

## **AUTHOR CONTRIBUTIONS**

EW, AT, and EA designed the study, AT collected the data, EW and AT analyzed the data and wrote the paper with input from all authors.

## **CONFLICTS OF INTEREST**

The authors declare that there is no conflict of interest.

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## **APPENDIX: SURVEY QUESTIONS**

1. Is the procurement in line with the strategic sustainability objectives of the city?
2. Are there any specific policies (e.g., national or at city level) that promote greenness in procurement?

3. How do you consider the size of the SOLUTIONSplus procurement compared to the minimum size of the procurement of which you need to carry out the public procurement process?
4. Did you have knowledge on the guidelines and procedures on how to implement (green public) procurement?
5. What kind of selection criteria did you use? Minimum compliance criteria/award criteria/something else (please specify).
6. Did you use any tools/software to formulate the selection criteria?
7. Was any detailed ex-ante impact assessment of the procurement carried out (e.g., due to legal obligation or substantial anticipated environmental, social or economic impacts)?
8. What are the types of data you consider important and necessary in the local procurement processes based on the city demonstration?
9. Can you specify the quantity and quality of the data?
10. Did it cost more/less to conduct SOLUTIONSplus e-mobility procurement compared to previous similar procurements?
11. Did it take longer/shorter time to conduct SOLUTIONSplus procurement compared to previous similar procurements?
12. Who were the actors involved in the procurement processes and what were their roles/duties?
13. Was there any collaboration between several procurers e.g., in developing the procurement documents and/or several suppliers in bidding for the contract?
14. Was there any collaboration with other local procurements/the SOLUTIONSplus procurements in other city demonstrations?
15. What was your impression on the procurement process in general?
16. Did you use the information provided in the SOLUTIONSplus demo ex-ante impact assessments for the procurement process (selection criteria)?
17. Do you have recommendations on how to collect, store and maintain data needed for the procurement in a cost-effective manner?
18. What were the main challenges encountered during the procurement process?
19. Can you name the best practices identified during the procurement process?

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