Decarbonization of the transport sector through dissemination of electric motorbikes: a guide for e-mobility stakeholders to carbon credits generation

Final report

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Abbreviations

CA	Corresponding Adjustments
CCP	Core Carbon Principles
CCQI	Carbon Credit Quality Initiative
CDM	Clean Development Mechanism
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CPA	Component Project Activity
ETS	Emission Trading Scheme
GHG	Greenhouse Gas
GS	Gold Standard
ICE	Internal Combustion Engine
IC-VCM	Integrity Council for the Voluntary Carbon Market
IPCC	Intergovernmental Panel on Climate Change
ITMO	Internationally Transferred Mitigation Outcome
MO(s)	Mitigation Outcome(s)
MRV	Monitoring, Reporting and Verification
NDC	Nationally Determined Contributions
PD	Project Description
PDD	Project Design Document
PP	Project Proponent
SDG	Sustainable Development Goal
SD VISta	Sustainable Development Verified Impact Standard

tCO2e	Metric Tons of Carbon Dioxide Equivalent
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VVB	Validation/Verification Body
VCM	Voluntary Carbon Market
VCMI	Voluntary Carbon Markets Integrity Initiative
VCU	Verified Carbon Units
VCS	Verified Carbon Standard
VPA	Voluntary Project Activities

Definitions

Term	Definition
Activity	For the purpose of this report, activity is used to identify both stand-alone projects and programmes that aim at reducing GHG emissions.
Baseline	Baseline emissions refer to the emissions that would have occurred if a project were not implemented, against which the emission reductions, removals or avoidance are calculated. Baseline emissions are calculated by the project proponent following the guidelines and requirements set out in the chosen methodology.
Carbon Credit	Unit representing an additional, monitored and verified ton of carbon dioxide equivalent (tCO_2e) reduced or removed against a valid baseline, issued under a crediting standard.
Crediting Period	Time period over which carbon credits can be issued for a mitigation activity (subject to periodic verification). Crediting periods can be renewable or not.
Crediting Standard	A crediting standard is a body that registers mitigation activities and verifies the reduction or removal of emissions, subsequently issuing carbon credits for each tonne of CO_2e according to the baseline and monitoring methodologies the standard has approved.
Methodology	Baseline and monitoring methodologies set out detailed procedures and requirements for quantifying the GHG emission reductions of specific activities, including the determination of project boundaries, identification of the baseline scenario, additionality demonstration, quantification of the emission reductions achieved, Monitoring, Reporting and Verification (MRV) of parameters. Crediting standards have methodologies that are approved and ready for use; alternatively new methodologies can be developed by third parties and approved by the standard if they meet the requirements.
Mitigation Outcome	Reduction or removal of one ton of CO_2e. Can be associated with: • GHG emissions reductions (e.g., displacing fossil fuel-based energy with renewable energy, or flaring landfill gas)

	• GHG emissions avoidance (e.g. reducing deforestation or capturing carbon from fossil fuel-based plants) and/or • GHG/carbon dioxide removal.
Programmatic approach	Development of a mitigation activity as a programme, i.e., as a combination of multiple underlying activities that compose the overall activity, and that can be implemented in different locations with diverse timelines. Programmes differ from stand-alone activities, as the latter comprise only one project that is well defined in terms of location and implementation timeline (i.e. no scale up or expansion allowed after registration).

Various crediting standards use different terms to describe the same concept. A breakdown of the terminology used by the Verified Carbon Standard (VCS) and Gold Standard (GS) can be seen here. For simplicity, VCS terminology is utilized throughout this report.

Table 1: Terminology used by GS and VCS

Gold Standard	Verified Carbon Standard	Definition
Certification	**Registration**	the process by which a project is listed (registered/certified) in the standard's registry after passing the validation phase. This step is necessary for the generation of carbon credits (after verification).
Design Certification	**Validation**	the process by which project documents are reviewed by an accredited third party to ensure project design is in line with the standard's requirements and the methodology (including calculations and other assumptions) is correctly applied to one activity. Upon successful validation, the project moves to registration in the standard's registry.
Performance Validation	**Verification**	the process by which mitigation outcomes of a project are confirmed by an accredited third party, ensuring that the actual performance of the activity is achieving emission reductions and the estimates are correct and conservative. Verification can occur only after an activity commences operation and after the activity has been registered under a carbon standard. Generation of carbon credits can occur only ex-post, i.e., based on the actual activity performance.
Programme of Activities (PoA)	**Grouped Project**	An approach where many individual activities (referred to as project activity instances/ Voluntary Project Activity), are included over time under a single grouped project "umbrella". Multiple instances can be included in a programme at different points of its lifetime through a streamlined process for validation.
Project Design Document (PDD)	**Project Description (PD)**	A document that specifies the details of the proposed activity, including project location and technology,

		methodology application, estimated emission reductions, MRV procedures and equipment, etc.
Project Developer	**Project Proponent**	The project developer or project proponent refers to the actor principally responsible for project design, implementation, and registration under a crediting standard. It is intended here as the actor owning the mitigation activity and thus called activity proponent in this report.
Voluntary Project Activity (VPA)/ Component Project Activity (CPA)	**Project Activity Instance**	Additional components or “instances” (i.e. specific projects) that are added over time to a grouped project/programme.

Executive summary

Curbing GHG emissions from the transport sector and especially from road transport is a crucial step in tackling climate change. Road transport is responsible for the emission of 5.8 $GtCO_2$/year or around 75% of the total annual emission from transport sector. Its impacts on climate will become more severe if the new vehicles that will enter the market will still use an internal combustion engine (ICE) running on fossil fuels, since the number of vehicles globally is expected to double by 2050. One solution that is increasingly gaining traction is the dissemination of electric vehicles to replace ICE vehicles. When charged with electricity from renewable sources or with electricity from power grids with low-carbon content per MWh, electric vehicles can significantly reduce GHG and other harmful emissions and also dependency on fossil fuels. Despite these benefits, e-vehicles, including e-motorbikes, are only slowing penetrating the market. Support is still needed for the full deployment of e-mobility solutions and to accelerate uptake of e-vehicles. This report focuses on the dissemination of e-motorbikes: this technology has a particularly high potential in certain geographies as two (and three) wheelers are very popular in many African and Asian countries (90% of the vehicles' growth to 2050 is projected to occur in low and middle-income countries) and are used for the provision of transport services for passengers and goods. E-motorbikes can thus contribute to both mitigation efforts as well as to the achievement of the UN Sustainable Development Goals (SDG), as they can reduce harmful emissions and can also represent a source of income for individuals.

Carbon credits' sale can generate additional revenues to support e-mobility solutions. However, to unlock the potential of carbon markets, it is important to understand what the requirements are to generate carbon credits, what the main activity design elements are as well as the procedural steps to register an activity under a standard and to generate carbon credits. The main standards in the voluntary market assessed in this report are Gold Standard and the Verified Carbon Standard. Several approved methodologies are applicable to e-mobility and specifically to e-motorbikes: we identified the CDM methodology AMS-III.C. The upfront costs and time required to complete the full cycle are not to be underestimated: registration and issuance may reach around USD 145,000-167,000 (depending on the carbon standard) and around one year for registration plus approx. three-six months for verification and credits generation[1]. It is estimated that the number of e-motorbikes needed to cover these transaction costs ranges between 7,000 and up to above 60,000 units, depending on the assumptions on the carbon credits price and on the actual performance of the e-vehicles. These estimates provide the number of e-vehicles that are required to generate sufficient revenues to cover the transaction costs with one issuance only: revenues from subsequent issuance of carbon credits can be reused by the developer for other purposes.

The information on requirements, timeline and costs of credits generation will support interested stakeholders, i.e. companies producing and selling e-vehicles and other entities interested in supporting e-mobility, to understand how the monetization of the carbon assets can support and accelerate e-vehicles uptake and contribute to a successful business model, while identifying the associated challenges to be addressed.

[1] Both costs and timeline are indicative and will have to be confirmed in real life based on the actual activity design, availability of supporting evidence, scope, size, selected standard and VVB. Verification can be performed only after the completion of the monitoring period for which credits will be issued.

1. Introduction

1.1. Scope of the report

The report aims at assessing viable options for registering ad generating carbon credits from the dissemination of electric motorbikes. While the methodologically the approach is the same for e-motorbikes, e-cars, e-buses, certain elements (e.g. baseline identification, additionality demonstration, estimation of the mitigation potential) can vary from one technology to another. The following sections will provide information on the main design elements of a mitigation activity, as well as on the carbon crediting process cycles under Gold Standard and the Verified Carbon Standard, including timeline and costs. It then compares methodologies that are relevant for the e-mobility sector (Section 3) while Section 4 discusses the interactions between the voluntary carbon markets and Article 6 of the Paris Agreement.
The goal is to provide a comprehensive description yet accessible also to non-expert readers of the carbon market requirements, associated costs and time, as well as potential challenges that can jeopardize carbon credit issuance.

1.2. Background

The transport sector is responsible for around 37% of CO_2 emissions from end-use sectors, reaching 7.7 $GtCO_2$ in 2021, of which around 5.8 $GtCO_2$ are due to road transport (IEA 2022a). Despite a slight decline in the sector in 2020 because of the Covid-19 pandemic (IEA 2022a), it is still one of the fastest-growing CO_2-intensive sectors considering that the number of vehicles in the world is expected to double by 2050 (UNEP n.d.), with more than 90% of this growth projected to occur in low- and middle-income countries (UNEP n.d.). The deployment of electric vehicles (EVs)[2] is one of the most promising solutions to streamline and reduce the climate impact of the transport sector (UNEP n.d.). Globally, electric cars sales (including battery hybrid cars) have been increasing steadily in the past few years, ranging from 120,000 in 2014 to 6.6 million in 2021, accounting for 9% of the total sales (IEA 2022b).

While some encouraging signals can be observed, most vehicles sold worldwide are still based on the thermal engine. This calls for stronger efforts to increase uptake of electric transit and subsequently reduce GHG and other harmful emissions associated with thermal engines. Given the relevance of the transport sector, several new companies are entering the market and focus their efforts on the production and dissemination of different types of EVs also in developing countries.

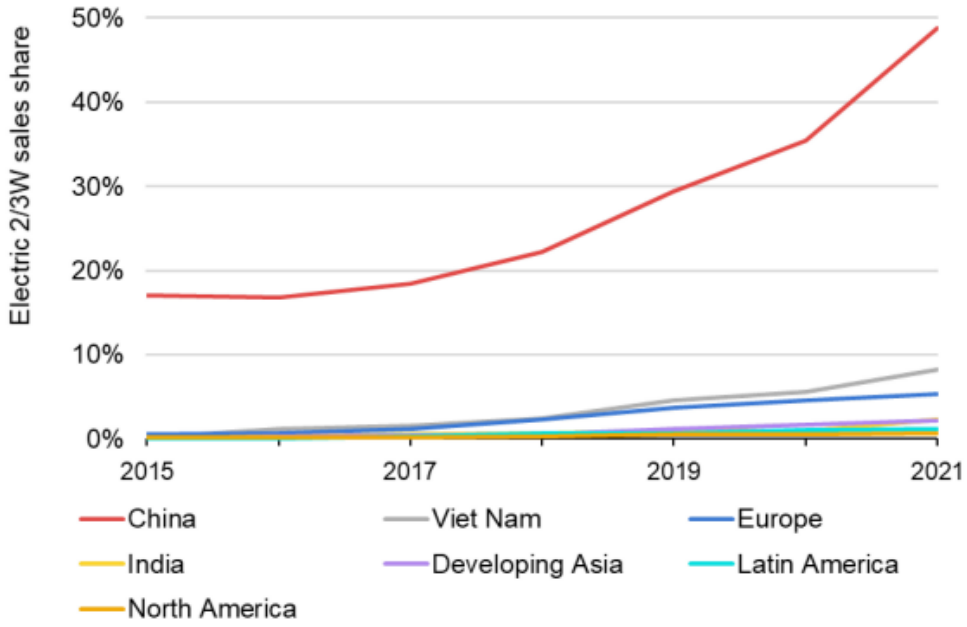
When zooming on Africa, some estimates show a limited contribution to global transport emissions, as the continent is responsible for only 5% of the total emissions at global level and have low emission per capita[3] (SLOCAT 2021). However, the expected growth of the transport sector requires immediate action now to support the dissemination of e-motorbikes to decarbonize the sector and reduce harmful impacts of ICE motorbikes, given the increasing population and very fast urbanization in a region where motorbikes are

[2] There are many types of e-vehicles: electric cars, buses, buses, trucks and other heavy or light duty vehicles, off-road vehicles, electric motorbike and bicycles, electric boats. For the purpose of this report, we focus on e-motorbikes dissemination with a focus on Africa and specifically in Uganda. However, general observations are valid also for other countries in the regions and beyond.
[3] Global average emissions related to transport in 2019 reached 0.89 tCO_2e, with Africa only reaching 0.25 tCO_2e (SLOCAT 2021).

one of the most common modes of transport for passengers and goods. This situation is similar also in Asia: in both cases motorbikes provide a primary mode of transport and are a promising option to incorporate EVs into the transport mix and reduce associated GHG emissions. Africa, despite the huge potential, is still lagging, with annual of EV, representing the world's smallest EV market (IEA 2022b). When looking at two/three wheelers, Africa also lags other continents in terms of electric two- and three-wheeler vehicles sold (IEA 2022b). In terms of new sales, China accounts for the majority of the new e-motorbikes sold globally (around 9.5 million two/three wheelers out of the global total of around 10 million units) followed by India (300,000), Viet Nam (230,000) and Europe (87,000).

The following graph shows the share of new sales for two/three wheelers by region, and Africa is not represented (2015-2021).

Figure 1: Electric two/three-wheeler sales share by region (2015-2021)



Source: IEA 2022b

Some estimates (McKinsey 2022) predict that the number of vehicles in Africa will more than double by 2040[4], with most of these vehicles being imported used vehicles. Demand for motorbikes in sub-Saharan Africa is significant and many transport and taxi services are provided by motorbikes (commonly called boda boda) that is expected to represent around 50% of the total vehicles in the region by 2040 (McKinsey 2022). It is also estimated that electric two-wheelers will reach between 50 and 70% of the new sales by 2040 (McKinsey 2022). Decarbonizing this sector and limit the dissemination of internal combustion motorbikes to avoid lock-in effects, is crucial to curb emissions and reduce fossil fuel consumption. As reported by IEA (2022b) a few countries in Africa, led by South Africa, are moving their first steps towards e-mobility, with discussion on policy support and new companies that plan to install or expand production

[4] The estimates cover South Africa, Kenya, Rwanda, Uganda, Ethiopia, and Nigeria. These countries account for 70% of the total sales of vehicles in sub-Saharan Africa, and 45% of the population.

capacity for e-vehicles (from e-buses to e-motorbikes)[5]. However, this indicates that there is still the need to close this gap with other regions of the world.

Carbon markets can be a promising source of finance for the e-mobility sector and can support the e-motorbike dissemination. Given the high investment cost of EVs compared to internal combustion engine alternatives (despite the potentially lover total cost of ownership over the lifetime, compared to ICE vehicles), income from the sale of carbon credits may be able to play a role in providing the additional financing needed to scale up electric transport in Africa and accelerate uptake by drivers. E-mobility sector is gaining importance, but it is still in an initial phase of development and additional support is needed. However, the process of certifying an activity under a carbon standard requires time and resources. Given the importance of the transport sector, and especially of two-wheelers in sub-Saharan Africa, this document provides an overview of the key considerations when designing a carbon activity for the dissemination of electric motorbike for the generation of carbon credits in the voluntary carbon market (VCM) in Africa. It also describes some of the key features of carbon crediting activities and associated costs, as well as a comparison of the available methodologies and crediting standards (focusing on Verra's VCS and Gold Standard). Decisions must always be tailored to the underlying activity that will be implemented: this document is intended to give a general overview of the options available and potential pros and cons of certain design features, crediting standards and methodologies for e-motorbikes, as well as estimate the costs of validation and verification under a carbon standard, which is a necessary condition for the generation of carbon credits. Many of the findings of this report are, however, applicable in general to carbon asset development, and are relevant in other geographies and also for other e-mobility solutions that can apply the same methodological approach (see Section 3).

2. Key design features of carbon crediting activities

A carbon credit is a quantified mitigation outcome representing one metric tonne of CO_2e of GHG emission reduction, avoidance, or carbon dioxide removal that is generated by eligible activities certified under a crediting standard (such as GS's Gold Standard for Global Goals or Verra's VCS). Though there are many crediting standards, this guide focuses on GS and VCS as the largest and most well-known standards, providing the recognition and reach that allow project proponents to access buyers. In this report, we do not cover explicitly potential opportunities in the compliance market, e.g., under the Article 6 of the Paris Agreement whose operational rule are currently being discussed and its implementation is expected to take 2-3 more years. However, we explore briefly how the two market segments are interacting.

Carbon standards issue carbon credits *ex-post* (i.e., after the proposed activity commences operations and subject to third party verification) for mitigation outcomes that meet the standard's requirements, which typically reflect established criteria to ensure environmental integrity by demonstrating additionality,

[5] Examples are reported for South Africa, Rwanda, Uganda, Kenya, Egypt.

applying robust baselines, monitoring and reporting, addressing non-permanence, avoiding double counting, etc.[6].

When designing an activity that is suitable carbon crediting, certain element must be defined, such as the activity size, scope, whether the activity can be submitted as a stand-alone or as a programme, selection of the technological measures involved identification of an applicable methodology and preliminary estimation of the emission reductions, as well as demonstration of additionality, plans for upscaling over the lifetime of the activity. Activity proponents must also consider how to monitor and report the mitigation impacts (i.e., the performance of the activity) as this will be the basis for the generation of carbon credits and the sustainable development contribution of the activity. In principle, EVs can reduce GHG emissions through the replacement of fossil fuels (such as gasoline and diesel fuel) with electricity: if the electricity is produced through renewable energy, this mitigation impact can be stronger.

In the VCM there are two prominent standards: the GS and the VCS. The carbon crediting cycle is quite similar for both standards and the key steps resemble each other. These key steps are as follows:

1. **Initial activity design and preparation of activity documentation.** The activity proponent selects an approved methodology (or more than one, if multiple measures are covered by the activity) and applies it to the activity, including the demonstration of the additionality, determination of a crediting baseline, quantification of the emission reductions/removals and a monitoring plan in line with the requirements of the selected carbon crediting standard;
2. **Validation of the activity by an independent third party**, based on the documentation and supporting evidence confirming the correct application of the methodology;
3. **Registration of the activity** (subject to a positive validation by the third party) **under the carbon crediting standard**;
4. **Implementation of the activity**, including monitoring and reporting of the activity's emissions and resulting mitigation outcomes (monitored by the activity proponent), in line with the monitoring plan and other relevant standard's requirements;
5. **Periodic verification** of the monitored and reported activity emissions and resulting mitigation outcomes by an independent third party (i.e., the amount of CO_2e reduced by the activity and that can be issued as carbon credits); and
6. **Issuance of carbon credits** against verified mitigation outcomes under the carbon crediting standards.

After the activity generates carbon credits, the activity proponent can proceed with the **sale of carbon credits.** Different options are available, such as bilateral agreement with buyers through a signed commercial agreement (often referred as Mitigation outcome purchase agreement – MOPA) which can define specific payment structures, volumes, prices, and delivery time. Alternatively, the activity proponent

[6] Additionality demonstration is one of the main challenging tasks, as it is the demonstration that the project would not have been implemented without the incentive provided by the underlying mechanism, such as revenues generation from the sales of carbon credits. Traditionally additionality has been challenging and one of the most questionable elements of carbon projects (Michaelowa et al. 2019)

can utilize specialized platforms or a broker company to sell the credits on the market. This step is not part of the registration or issuance process under a carbon standard and these commercial agreements can be freely structured by the activity proponent and the buyer. There are estimates for large scale activities quantifying the cost of managing the MOPA at around 0.3 USD per credit (Schwieger et al. 2019).

2.1. Key design features

When designing an activity that is suitable for crediting, there are several decisions that must be made and that affect the methodology that will be used, how activity outcomes will be monitored, and which standard is most applicable to the activity. These decisions include whether to choose a stand-alone or a grouped project (also referred to as a programme of activities under Gold Standard and the Clean Development Mechanism - CDM), what the geographical and technological scope of the activity will be, definition of scaling up plans, which crediting standard will be used to register the activity and issue carbon credits, as well as which applicable baseline and monitoring methodology will be chosen by the activity proponent. An overview of these considerations can be seen in The following textbox looks more closely at the role of the managing entity and its importance for the implementation of the program.

Box 1: Role and importance of the Managing entity

A key element for the successful implementation of the program is the managing entity. In principle any entity could be playing this role, including the developer of the activity, as long as it has the legal power and also the required expertise and capacity to run the program from its design to its full implementation. Performing the required tasks will require the availability of sufficient financial resources to cover expenses related to staff, offices and daily operations, over the lifetime of the program. In addition, for a successful program the managing entity should have the following competences and expertise:

- **Managerial,** to develop and implement a solid business model, management of timelines, engagement with different stakeholders (including national authorities); design of MRV and responsibility for its implementation, play an active role in the validation and verification, management of resources for the implementation of the program. The implementation of the program and the specific steps of the carbo credit cycle require liaising with external consultant and also with the VVB during validation and verifications, technology providers, national authorities and sector regulators, as well as local communities and other stakeholders. Another crucial role is the management of the expansion plan of the program, potentially to multiple countries and/or technologies (including different e-vehicles allowed under one methodology)
- **Financial,** performing controlling functions, ability to manage different financial instruments (if required by the program), oversee of financial flows to the program (e.g. revenues from carbon credits) and to outside the program (staff salaries, procurement of goods and services, etc.)
- **To perform MRV**, ensuring the system meets the standard's requirement, including the required hardware and software, and that the data collection is seamlessly implemented to allow accurate estimation of the mitigation potential

- **Legal**, to be able to develop and sign contract between the different stakeholders such as the e-vehicles drivers or intermediaries on the ownership of the carbon credits, legal contract with the buyers of the credits, and oversee their enforcement

Different solution can be explored and tailored to the specific program and stakeholders' needs. The following table shows the key design features for a carbon crediting activity.

Table 2.

The programmatic approach

The programmatic approach (i.e., the so-called grouped approach under Verra) was developed under the CDM to provide a streamlined and cost-effective option for the registration and subsequent generation of mitigation outcomes for activities that are small and dispersed geographically and over time, and thus not well suited for the traditional project-based approach. Programmatic approaches are particularly suited for EV-related activities since additional instances with batches of new vehicles to be disseminated can be added over time to scale up dissemination and accelerate electric vehicle uptake, as well as maximizing the volume of emission reductions that can be achieve. The main reasons are the following:

- The mitigation potential of each e-motorbike is expected to be rather small and thus a sufficiently large number of vehicles is needed to achieve a sufficiently large volume of emission reductions and make carbon credits generation viable. The programmatic approach can capture the scaling up plans over time of the activity proponent to increase the overall mitigation potential;
- New activities can be implemented over time at different locations (potentially also in multiple countries), as would be the case for the dissemination of e-vehicles in normal operation by the producers;
- Activity proponents may not know in advance the actual scope and pace of disseminating e-vehicles, i.e., the total number and type of vehicles, locations and start dates. The programmatic approach does not require full clarity on these key elements from the start (i.e., at registration): provided that eligibility criteria are met, new activities (called project activity instances under VCS) can be added over time bypassing the validation and registration process, which can be risky as well as time and resource consuming;
- Potentially, different e-vehicles (even from different technology providers) can be included under the same group;
- Small-scale thresholds that allow for the use of simplified methodologies (i.e., maximum emission reduction of 60.000 tCO_2/year) would not be applied to the entire programme but to the specific activity. This means that each project could not exceed the threshold, and no upper limit to the overall mitigation potential of the group is set. New activities can be included over the crediting period;
- Verifications could be conducted in a collective manner.

However, **challenges must also be considered when evaluating the programmatic approach to carbon crediting.** The implementation requires a strong coordination of the different activities, ensuring coordination and management during implementation, effective monitoring over time for an increasing number of activities, ensuring that the necessary capacity to run the specific activity is in place. It is important to ensure supervision and management of the overall programme implementation to address potential challenges as they materialise and liaising with the carbon standard and with national authorities as needed. In addition, mitigation outcomes are generated by the actual drivers of the EVs: a contractual agreement is thus needed between the activity proponent and coordinator and the end users to ensure clear ownership of the resulting emission reductions and avoid any potential double counting of the same emission reduction unit. The distribution of the revenues within the grouped project can be freely structured and it is organized by the managing entity that shall define these elements in advance. Revenues allocation refers to both the flow of revenues from the credits' buyer to the programme and within the programme, between the different participants. In the former case, the agreement is part of the purchase agreements and allows to structure payments with flexibility allowing the parties identify the most suitable commercial structure for them. It is important that the ownership of the carbon credits is clearly defined before the implementation of the activity, through contractual agreements between the users and the activity proponent. When looking at the allocation of revenues within the programme, it is possible for instance to pass part of the revenues to the final EV users providing a discount on the initial price of the e-motorbikes, or a discount on the cost of electricity for recharging the EVs (if charging is centralised) or a payment on a periodic basis from the managing entity to the other actors in the value chain. The following textbox looks more closely at the role of the managing entity and its importance for the implementation of the program.

Box 1: Role and importance of the Managing entity

A key element for the successful implementation of the program is the managing entity. In principle any entity could be playing this role, including the developer of the activity, as long as it has the legal power and also the required expertise and capacity to run the program from its design to its full implementation. Performing the required tasks will require the availability of sufficient financial resources to cover expenses related to staff, offices and daily operations, over the lifetime of the program. In addition, for a successful program the managing entity should have the following competences and expertise:

- **Managerial,** to develop and implement a solid business model, management of timelines, engagement with different stakeholders (including national authorities); design of MRV and responsibility for its implementation, play an active role in the validation and verification, management of resources for the implementation of the program. The implementation of the program and the specific steps of the carbo credit cycle require liaising with external consultant and also with the VVB during validation and verifications, technology providers, national authorities and sector regulators, as well as local communities and other stakeholders. Another crucial role is the management of the expansion plan of the program, potentially to multiple countries and/or technologies (including different e-vehicles allowed under one methodology)

- **Financial,** performing controlling functions, ability to manage different financial instruments (if required by the program), oversee of financial flows to the program (e.g. revenues from carbon credits) and to outside the program (staff salaries, procurement of goods and services, etc.)
- **To perform MRV**, ensuring the system meets the standard's requirement, including the required hardware and software, and that the data collection is seamlessly implemented to allow accurate estimation of the mitigation potential
- **Legal**, to be able to develop and sign contract between the different stakeholders such as the e-vehicles drivers or intermediaries on the ownership of the carbon credits, legal contract with the buyers of the credits, and oversee their enforcement

Different solution can be explored and tailored to the specific program and stakeholders' needs. The following table shows the key design features for a carbon crediting activity.

Table 2: Key design features of carbon crediting activities

Design element	Description and relevance for e-mobility
Program vs stand-alone project	**Stand-alone project**: Focus on a single activity that generates mitigation outcomes. Monitoring and verification may be easier, but potential for upscaling is limited as activities would have to be registered independently thereby increasing transaction costs. **Grouped project/Programmatic approach**: An approach where many individual activities (referred to as project activity instances under VCS), potentially with different features and start dates, are included over time under a single programme/grouped project "umbrella". Multiple instances can be included in a programme/grouped project at different points of the program/grouped project lifetime through a streamlined process, enabling gradual expansion of a project and achieving greater scale. **Relevance for e-mobility:** a programme/grouped project seems more suitable as the introduction of the EVs is likely to occur in a phased manner over a few years. Given the limited mitigation potential of each e-motorbike, a grouped project would also allow a sufficient critical mass of vehicles to achieve break-even point when considering the cost associated with the carbon cycle (i.e., document development, validation, registration, verification, and issuance). At the same time, it would significantly reduce cost and complexity of adding new instances (i.e., specific projects that can generate carbon credits reducing transaction costs for the proponent.
Scale	Activity instances and grouped projects can be defined according to the installed capacity or electricity savings achieved or total volume of carbon credits emitted. GS categorises activities as: **micro** (with less than 10,000 tCO_2e reduced per year); **small** (up to 15 MW for renewable energy activities, or up to 60 GWh saved per year for energy efficiency or less than 60,000 tCO_2e generated per year for other activities) and **large**¸ that exceed previous thresholds (GS 2022a). VCS has just two categories: activities reducing up to 300,000 tCO_2e per year), or large activities that reduce more than 300,000 tCO_2e per year (VCS 2022a). Simplified methodologies are applicable to small and micro scale activities. **Relevance for e-mobility:** A grouped project comprising several small-scale activity instances may be more suitable when implementing e-mobility

	activities, especially regarding e-motorbikes. This follows the same logic of the previous item The final decision, however, depends on the actual scale up plans, the total number of EVs that will be introduced, the dissemination timeline and intention to introduce e-motorbike in other countries.
Technological scope	Both grouped projects and stand-alone activities may either apply one methodology or combine different methodologies, for instance if different mitigation measures/technologies are deployed under the same activity and are not covered by a single methodology. The technological scope is very important as it will also guide the decision on whether a single methodology or a combination of methodologies is used as well as the applicability of the selected methodology (along with other considerations). The combination allows more flexibility in covering several technologies/measures under the same activity or grouped project increasing the mitigation potential, but a multi-technology grouped project (or activity) may increase complexity at validation. **Relevance for e-mobility:** The focus of the grouped project/project is e-mobility, specifically on e-motorbikes, thus one technology is targeted. This also applies to different types of EVs, i.e., buses, cars, e-motorbikes that have similar uses (i.e., transport of goods and people) that are covered already under existing methodologies. In principle, the same methodology could be applied to different types of e-vehicles (see Section 3).
Location and geographic scope	**Rural/urban**: In general, scaling up opportunities are more relevant in urban areas, given the higher density of vehicles and more concentrate possibility of charging infrastructure installation, whereas a rural context may have more important sustainable development contributions. The differences also depend on the host country and the actual context where the activity is implemented as well as the actual use (i.e., distance travelled every day) of the EVs and also the access to grid electricity to renewable off-grid recharging options. **Country coverage**: A grouped project structure can cover different locations in one or several countries. This is the case of the East African context for example, there are currently many ongoing e-mobility initiatives, whose efforts may be consolidated in a grouped project structure. A stand-alone project, on the other hand normally focuses on a defined location(s) within one country. **Relevance for e-mobility**: If a grouped project is selected, the geographical scope is likely to cover at least the entire host country where it is implemented. However, there could be cases of grouped projects that are covering several host countries. In the case of e-mobility where the activity proponent intends on expanding their operations and disseminating vehicles across several countries, there is the potential to lump different host-countries together and maximize synergies as well as the mitigation potential. Several countries in Africa present similar situations, with limited penetration of e-vehicles, large markets for e-motorbikes, and activity proponents may be interested in covering two or more countries under the same activity. Implementation timeline (i.e., the timeline for the dissemination of e-vehicles in additional countries) is also important as the scale up plan shall be consistent with the crediting period of the activity. In addition, the actual application of the methodology in the different countries' context needs to be assessed.

Carbon crediting standard selection	We consider in this report two main crediting standards in the VCM, the GS and the VCS Both standards require reporting on sustainable development contributions though the reporting framework, however the extent of verification varies between the two. VCS also has a specific methodology for e-mobility. **Relevance for e-mobility:** The most appropriate standard should be selected depending on the design of the activity and its geographical location, as well as the intensity of the sustainable development contribution and possibility to monitor them over time. Under VCS, if the VM0038 is used, additionality is automatically demonstrated for a list of selected countries (VCS, 2018a). However, the list does not comprise African countries so far (VCS 2018b). For both VCS and GS, CDM methodologies can be used. Potentially commercial considerations may play a role (e.g., preference of a specific buyer for one standard, price that can be yielder per credit).

2.2. Carbon credit project cycle

For an activity to be registered under a crediting standard, an applicable monitoring methodology must be selected and used to properly account for the emission reductions associated with the activity. The methodologies comprise the following key procedures and requirements:

- **Definition of the scope and applicability conditions**
- **Boundary definition and inclusion of the emission sources**
- **Procedures to identify the baseline**
- **Procedures to demonstrate additionality**
- **Equations and approaches for the quantification of the baseline emissions, project emissions and leakage (where relevant), thus for the estimation of the actual mitigation impact of the activity (i.e., the volume of carbon credits that can be achieved, in tCO_2e/year)**
- **Requirements for the MRV system and associated procedures**

It is important to highlight that entering the validation process and successfully reaching registration may be a challenging task. This refers to the need for keeping abreast with the carbon standard requirements for activities; ensuring the correct application of the methodology, including a conservative estimate of the mitigation potential that can be achieved, collecting all supporting evidence that justifies assumptions and calculations; and the need to interact with the carbon standard and validation and verification body (VVB) during the validation (and subsequently verification) process to address comments and clarifications which may result in amendments to the activity documents and mitigation estimates. There are specialized companies that can provide professional support for different steps of the process who can be hired in case these competencies and expertise are not available within the activity developer's organization[7].

A methodology (or combination of multiple methodologies, if needed) shall be selected by the activity developer, ensuring applicability to the underlying activity, and described in detail in the activity description

[7] The cost associated with these consultancies is not included in the cost estimates provided in Report

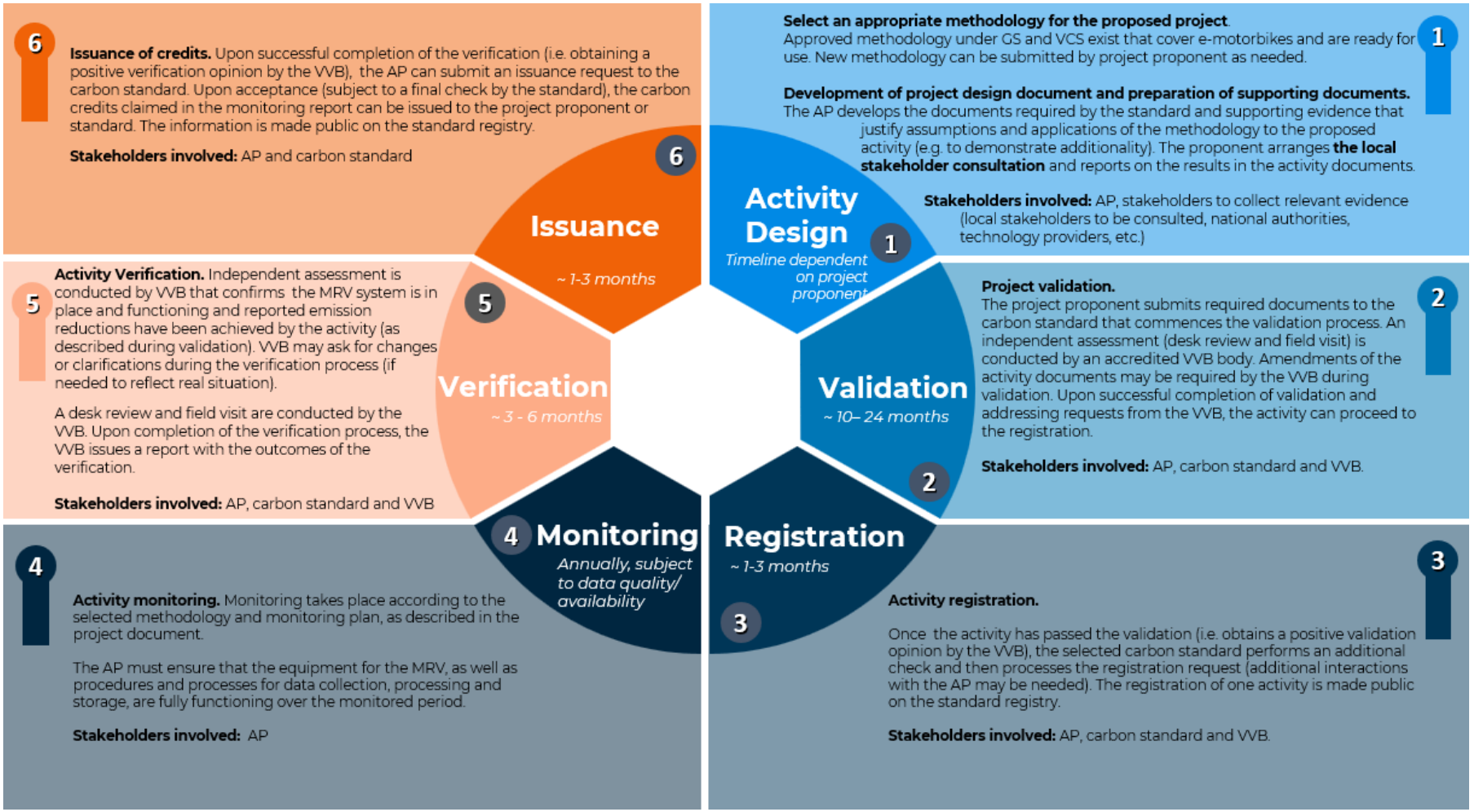
for the validation step. It must also be followed during the activity's operations to generate and issue carbon credits.

When deciding whether to commence the validation of a mitigation activity, it is important to consider that under both GS and VCS the registration and issuance processes are fully public. This means that the actual activity description document and the information contained (e.g. details on the technology, stakeholder consultation, data sources used, estimation of emission reductions, potentially financial data, etc.), the validation/verification report from the VVB, as well as the decisions from the standard on registering or rejecting an activity and those on credit issuance (including quantity of credits to be issued) will be made publicly available by the carbon standard. Specific data or information can be labelled as confidential and thus only be shared with the carbon standard and the VVB (i.e., not publicly made available by the carbon standard).

Both standards foresee extensive engagement with the stakeholders affected by the activity: the local stakeholder consultation, including the comments and complaints received, must be reported, and duly addressed in the activity description document. In addition, during validation, any activity is open for comments to the general audience, i.e., the activity description is published on the standard's website/registry and any interested stakeholder can provide comments. If these are relevant, then activity proponent must properly address them in the activity documents to successfully complete validation.

The carbon credit cycle, including typical periods for each step can be seen in Figure 2 (AP indicates the Activity Proponent). Details on each step under both GS and VCS are provided in Table 3.

Figure 2: Typical certification cycle according to established crediting standards



Source: Authors elaboration

Details on the steps described in the above figure are provided in the following section. There are some key steps that are commonly challenging when seeking registrations: baseline identification, additionality demonstration and design of the MRV system. These elements vary depending on the activity type/technology, its location and regulatory framework. They are very important to ensure environmental integrity and transparent and accurate accounting for the emission reductions that are achieved.

Baseline identification indicates the process of identifying a scenario that is representative of the development of the GHG emissions that would most likely have occurred in absence of the proposed mitigation measure and against which emission reductions can be claimed. The environmental integrity of crediting mechanisms is ensured by the robustness and conservativeness of the baseline and prevent the issuance of credits if actual emission reductions have not been achieved. Regarding baseline identification in the context of e-motorbikes in Africa, the identification of the baseline scenario is rather straight forward, as generally motorbikes are used for goods and passengers' transportation and have a gasoline ICE[8]. However, the situation may change with the rapid introduction of e-vehicles but, more details are required to identify the baseline for an activity: this means looking at the power capacity and other technical specifications of the motorbikes that will be introduced, to identify a similar vehicle that will be reasonably replaced by the EV and thus displace the use of fossil fuel (gasoline) reducing the associated emissions (net of the project emissions, i.e. emissions associated with the electricity that is used to change the EV). The challenge with baseline setting is to identify credible baselines that do not lead to the overestimation of emission reduction, which would jeopardize environmental integrity, while too strict baselines would excessively reduce the volume of emission reductions achievable.

Regarding the identification of the **project boundary**, it is defined (for e-motorbikes activities) as the location where the e-vehicles operate and it shall also include the recharging infrastructure; the facilities supplying electricity for the recharging facility (e.g., grid and/or renewable energy mini-grid, etc.); and other ancillary facilities. The main emission source to be included is carbon dioxide (CO_2, both in baseline and project scenarios) while methane (CH_4) and nitrous oxide (N_2O) can be included.

Additionality demonstration is another challenging step. The concept essentially indicates that any mitigation activity must demonstrate that it would not have occurred (and thus the resulting mitigation outcome) without the support provided by the mechanism itself. Traditionally demonstration of additionality has been challenging and one of the most questionable elements of carbon projects as it requires the definition of a fictious scenario that is ultimately not easily demonstrable, as in the case of the CDM, where a number of projects registered under the UNFCCC had questionable additionality assessments, i.e. the projects would have been likely implemented anyway even without the support from the additional credit revenues (Michaelowa et al. 2019). Additionality is important for ensuring environmental integrity and for an efficient allocation of the available resources. Additionality can be demonstrated through the identification of more financially attractive alternatives to the credited activity that would result in higher emissions or the

[8] Diesel motorbikes are virtually non-existent.

existence of barriers preventing the implementation of the activity without crediting. One viable alternative to additionality demonstration is provided by certain methodologies that allow the use of the market penetration rate of a specific technology: if it is demonstrated that the actual penetration rate of the technology is below a pre-determined threshold, then the activity is deemed additional. The penetration rate seems a viable approach for e-motorbikes, at least in the short term. In virtually every country e-motorbikes are a very little fraction of the total number of motorbikes, even if trends are changing and in the near future more e-motorbikes will enter the market every year. This approach, when allowed by the methodologies, would demonstrate additionality in a rather straightforward manner if data covering the geographical location of the activity is available. Alternatively, assessing financial viability may not be too easy. This is because overall the total operation cost of e-motorbikes is lower than ICE motorbikes, mainly due to lower fuel cost and less maintenance needed, and although the initial investment may be higher for an e-motorbike, financial additionality (i.e., demonstrating that using an e-motorbike is not the most financially attractive option) may not be feasible to demonstrate. Additionally, if and when the charging infrastructure is part of the mitigation activity (i.e. not only dissemination of e-motorbikes but also the investment in the construction and operation of charging and swap stations), then the activity may be additional due to the additional investment cost to be considered in the assessment (but also potential additional revenues would have to be accounted for, e.g. the fee for recharging). However, a detailed evaluation of each activity would be needed to demonstrate the financial additionality given the several parameters involved, such as initial motorbike cost, cost of electricity, cost of gasoline, fuel and electricity consumption, refurbishment of batteries for EVs, maintenance costs, investment cost for the recharging systems, including associated costs and revenues, etc.

The third key element is the design of a robust MRV system. Carbon credits are issued only ex-post, i.e. after the activity commences operations. The actual performance of each component of the mitigation activity (e.g., each e-motorbike) needs to be properly monitored, i.e. ensuring accuracy of the measurements, solidity of the calculations used as well as the reliability input parameters. An MRV system, however, is not only defined by the actual monitoring and calculation approach to emission reduction estimates, but also comprises other elements including roles and responsibilities for running the system properly during the activity operations and to ensure quality assurance/quality control functions. It also comprises requirements and procedures to ensure the functioning and accuracy of metering devices or other devices that are used to collect the required data, for instance ensuring proper calibration and functioning of electricity meters. Furthermore, definition of responsibility and clear processes for the data collection and storage are important for a functioning MRV. A robust MRV system is key to the accurate quantification of the tCO_2e that have been reduced and that may be issued as carbon credits. While certain operational data is collected by the operators as part of their routine reporting (for instance the electricity used to recharge a e-motorbike in a charging station), some other parameters may be needed only for the quantification of the carbon credits. In the case of e-motorbike dissemination, MRV could be straightforward, especially where EVs recharge at centralised sites with metered electricity. For other activities, e.g., dissemination of e-motorbikes that do not necessarily utilise centralised charging systems (e.g., customers charge the EV in their home), the monitoring may become more complex as sampling of the circulating e-motorbikes would be needed to gather the required data. In this context, digitalisation of MRV can play a

significant role in reducing transaction costs and complexity, as well as increasing accuracy. Data could be transferred directly from the battery, both electricity consumed, and distance travelled along with other data if needed, which combined with other parameters could be gathered easily (e.g., default parameters for instance on the carbon content of gasoline) and would allow the quantification of the emission reductions achieved by each EV almost in real time. Potential issues relate to the malfunction of the 'smart' batteries transmitting data and where internet connection for the gathering of the data may not be stable, such as Least Developed Countries or rural areas in sub-Saharan countries, provided that accuracy of the data transferred is ensured. Quality assurance procedures will have to be defined for these cases to ensure conservative estimations of emission reductions are achieved.

The first round of verification (which involves a VVB) tends to be more time-consuming than subsequent rounds due to learning processes of the staff involved and identification and closing of initial data gaps/errors. Generally, but not mandatorily, a monitoring period (i.e., the time interval over which carbon credits are generated) covers one year of operation, but if needed or if the volume of carbon credits to be issued allows, shorter (or longer) monitoring periods can be identified. The verification and issuance process can take 3-6 months from the submission of monitoring reports to a carbon standard.

Box 2: Documents required for validation and verification

To start and successfully complete the validation and the verification processes, a set of documents are required. The required documents can be divided into two main categories: documents that are mandatory to commence the validation for verification and supporting evidence. The latter can be documents of a very different nature, from technical documents (drawing, manufacturer specifications, etc.), to legal (government approvals, licenses, Environmental and Social Impact Assessment, etc.), financial (motorbikes' initial costs, operational costs, existence of programmes or initiatives providing financial support to e-motorbikes etc.) commercial (contracts, commercial agreements) and beyond these categories (stakeholders meetings notes, research/publication to justify a certain baseline scenario etc.). Ideally these documents must be prepared before commencing the process (either validation or verification), as in most cases they will be required by the VBB or carbon standard throughout the process (i.e., to clarify or justify assumptions or the application of the methodology). The list provided here is not intended to be exhaustive, but it serves to clarify what documents are needed for completing validation and/or verification of an activity. Specific context of the activity, or request by the VVB may result in the need to obtain/develop other evidence. Where possible, it will also indicate the main stakeholders that could be relevant for obtaining these documents.

- **The activity proponent** is tasked with the provisions of the activity description documents, the monitoring report, and all supporting evidence. The activity proponent can be supported in the collection and preparation of these documents. Consultants can support with developing the activity description (including application of the methodology) and monitoring reports, as well as in the identification of existing evidence like publications, studies, and national statistics that are needed to justify or clarify the demonstration of additionality, baseline identification and other assumptions and parameters used. The activity proponent will also be responsible for providing any document like contracts, legal authorizations, technical descriptions that may require the cooperation with other entities, such as national/local governments, technology providers, contractual counterparts.
- **The VVB** performs the validation/verification, and it issues a validation/verification report, with the final opinion on whether the activity meets the requirements to complete the step. VVB validate that the requirements of the selected carbon standard are met and confirms the correct application of the methodology and the conservative estimation of the emission reductions to be achieved by the activity. Where needed the VVB can raise questions and request changes in the documents

or activity design, to meet the carbon standard and methodology requirements. These documents (validation/verification reports) are necessary to move to the next steps for registration or issuance. The VVB can request additional data or evidence as needed during both validation and verification.

- **Carbon standards** utilize the document received by the activity proponent to perform completeness checks, as well as the validation/verification opinion of the VVB, and to ensure consistency of the activity with standard and methodology requirements. Upon successful completion of the different steps, the carbon standard registers the activity or issues the carbon credits.

2.3. Crediting cycle under VCS and GS

GS and VCS are the most prominent voluntary crediting standards, offering global coverage of activities in a wide range of sectors. Under these standards, thousands of projects have been registered so far at global level. Both standards are endorsed by the International Carbon Reduction and Offsetting Accreditation (ICROA n.d.) In addition, carbon credits from both standards are accepted under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) which aims at the emission intensity in the aviation sector (ICAO 2020) However, the crediting cycle processes do not vary decisively between the two. There are other differences that may influence the activity proponent's decision to pursue crediting under one standard or the other, including cost, treatment of SDGs, etc.

Activity registration can last between 10-12 months (potentially also longer depending on the consistency of the project or grouped project with the standard requirements). This timeline also depends on the availability of supporting evidence that may be needed (upon request from the third-party validator or the carbon standard) to support and justify the assumptions and results presented in the activity documents (e.g. on additionality or quantification of the mitigation potential). The inclusion of an additional activity instance under a registered grouped project takes significantly less than the validation period that a stand-alone project would have to undergo. In the case of GS, for instance, inclusion could be as fast as four weeks, depending on the selected procedure (GS 2022b), which is significantly faster than a full validation process, that can easily take around 1 year (potentially longer) to be completed. Standard can perform random check to ensure proper inclusion of eligible activities. Validation is to be performed once before grouped project registration. Once the grouped project has been registered by a carbon standard, new activity instances can be included throughout the grouped project's crediting period whenever the activity proponent wishes to do so. Verification must be performed before each issuance. In the following table, the key steps for achieving registration under each standard are outlined.

The registration process is the same for both a stand-alone project and a programme. In the activity documents, a programme would also need to include a description of the inclusion criteria that would allow a new component activity to be included in the overall activity, i.e., the requirements that it must meet to ensure it is consistent with the programme and thus aligned with the standard and methodology requirement. Data on a specific project activity instance that will be the first component of the programme must also be submitted. Other documents required for validation are like the one for stand-alone project's validation. One addition is the requirement for a list of eligibility criteria that the new activities must meet to be included in the overall program. Similarly, for verification, the type of document that is required is the

same for stand-alone projects and programmes. In case of multiple project activity instances reaching issuance during the same monitoring period, the data and information provided in the monitoring report must cover all relevant activity components. During verification, the VVB may need to visit several locations where project activity instances are implemented, and the overall scope of the verification must consider the number of project activity instances under the programme.

The activity proponent hires the accredited VVB[9] for the validation process and to perform the verifications and bears the cost of these activities. The activity proponent also pays the fees as required by the carbon standard. For more details on the main documents (and involved stakeholders) for the registration and verification processes under both GS and VCS please see Annex 1.

[9] The list of accredited entities under VCS is available here while for GS is available here and are continuously updated.

Table 3: GS and VCS requirements on activities registration and credits issuance[10]

Steps	Gold Standard	VCS
Validation		
Local stakeholder consultation	It can be conducted either at programme or VPA level. Demonstration of stakeholder consultation at programme level is sufficient and conducted with the aim to get feedback from governments, relevant national authorities, NGO communities and other stakeholders on the programme design. In the case of a multi-country programme, relevant stakeholders across countries must be involved in the consultation. When the consultation is conducted at programme level, a physical meeting for stakeholders needs to be organised in parallel. After the physical meeting, a stakeholder feedback round is to be held. At the VPA level, a stakeholder consultation should at least take 2 months and comprise one mandatory physical meeting and stakeholder feedback round. During validation, activity documents are published on the standard website and are subject to public consultation and commenting.	- Activity proponent shall conduct local stakeholder consultation prior to validation to inform its design - Mechanisms for ongoing communication are also to be established - If comments are received, the activity proponent shall demonstrate to the VVB that it took into account all comments and implemented actions to address all comments During validation, activity documents are published on the standard website and are subject to public consultation and commenting.
Activity description	It comprises: ○ General description of activity ○ Application of methodology including information on project boundary, baseline scenario identification, additionality demonstration. Demonstration of compliance with applicability criteria ○ Compliance with applicable national and international regulations ○ Management system and inclusion criteria (for new VPA) ○ Crediting period (programmes for the selected activity type have a length of 20 years)	It comprises: ○ General description of the activity ○ Application of methodology including information on project boundary, baseline scenario identification, additionality demonstration. Demonstration of compliance with applicability criteria ○ Eligibility criteria for new instances inclusion ○ Compliance with applicable national and international regulations ○ Management system and inclusion criteria (for new VPA) ○ Sustainable development contributions ○ Quantification of GHG emissions reductions

[10] See also Figure 5 and Figure 6 in Annex I.

Steps	Gold Standard	VCS
	○ Sustainable development and safeguarding principles assessment ○ Quantification of GHG emissions reductions ○ Design of the MRV system ○ Description of the stakeholders' consultation process and results - If a programme is implemented, the proponent shall provide a description of the overall programme as well as the actual case of one component project activity.	○ Crediting period (seven years, twice renewable for a total of up to 21 years or ten years fixed) ○ Design of the MRV system ○ Description of the stakeholders' consultation process and results - If a programme is implemented, the proponent shall provide a description of the overall programme as well as or one actual instance of project activity to be included in the program
Preliminary review	Sustain CERT (official certification body of the GS) performs an initial review based on: - Completed Stakeholder Consultation Report - Draft Project Design Document (PDD), that includes the Safeguarding Principles Assessment - Estimation of climate and sustainable development impacts - Monitoring plan Once the review is passed, the activity obtains a preliminary approval called "Gold Standard Project Listed"	N/A
Validation by an accredited independent third-party entity	Once the "Gold Standard Project Listed" label is obtained the third-party validation can take place. It includes the validation of: - Project/programme DD - Application of the selected methodology, including additionality demonstration and baseline identification, length of the crediting period - Scoring of sustainable development indicators - Quantification of the mitigation impacts based on actual performance of the activity; consistency of the MRV system with the real situation and effective functioning - Outcomes of stakeholder consultation and how comments have been addressed - Overall consistency with the standard requirements	Includes the validation of: - VCS project description (see above) - Application of the selected methodology, including baseline identification and additionality demonstration, length of the crediting period - Quantification of the mitigation impacts based on actual performance of the activity; consistency of the MRV system with the real situation and effective functioning - Evidence of project ownership - Outcomes of stakeholder consultation and how comments have been addressed - Overall consistency with the standard requirements If validation is successful, the auditor issues a validation report and a validation representation that allows to move to the registration step.

Steps	Gold Standard	VCS
	Once validation is passed (i.e., auditor issues a positive validation report), the activity can obtain the “Gold Standard Design Certified” label	The activity proponent may also decide to submit an issuance request together with the registration of the activity. In this case, the proponent must also prepare the monitoring report and associated documents that will be verified by the VVB. Upon request for registration, the proponent must submit these documents to, including VVB opinions and both validation and issuance reports.
Project design review	Final assessment by SustainCERT based on PDD, validation report and can potentially lead to additional corrective actions to be addressed before full registration.	N/A
Registration	Once previous steps are passed, the activity obtains the “Gold Standard Design Certified”	Verra performs a completeness check and a final review of the submitted documents and may require additional clarifications. - Documents required for activity registration: activity description, validation report, validation representation, registration representation
VPA/Activity Instance inclusion to the Programme of Activities/Grouped Project	Once a programme has reached design certification, an additional VPA may be included into the programme of activities by submitting a VPA DD for inclusion. Prior to the inclusion, a compliance check must be conducted by the VVB with an emphasis on the inclusion criteria determined in the programme DD.	The VVB must validate the grouped project based on the initial project activity instances and assess at the same time the appropriateness of the eligibility criteria for determining the validity of future instances (projects) to be included. If a new instance meets the eligibility criteria defined in the overall programme description, then it can be included in the programme without entering the validation process.
Verification		
Monitoring report preparation	The monitoring report comprises: - Description of the project/activity instance performance - Identification and description of events that affected activity performance - Quantification of the actual performance of the activity, including actual data from the activity operation (e.g., metered energy consumption) - Estimation of the volume of emission reduction achieved in the monitoring period, following the approach and equations provided by the selected methodology	

Steps	Gold Standard	VCS
Performance review	- SustainCERT reviews documentation and requests clarifications and resolutions of corrective actions where required	- N/A
Verification by an approved third-party entity	- The third-party auditor assesses the monitoring report, performs a site visit to ensure full consistency of activity operations with the document description and can interview staff. - A verification report and verification representation are issued to the activity proponent (i.e., the result of the verification of the claimed emission reductions) at completion of the verification process	
Credits issuance	- Once all clarification requests (if any) have been addressed by the activity proponent, the activity gains the "Certified Gold Standard Project" label and issuance can proceed	- Verra reviews issuance request and stores project documents in repository - Once VCU issuance levy is paid, Verry deposits VCUs into project proponent's account - Verra registry shows status of every VCU issued under the standard (e.g., active, retired, cancelled)

Source: Authors' elaboration based on GS 2019a; GS 2022a, b; Verra n.d.; Verra 2023, Ahonen et al. 2021

2.4. Carbon cycle cost

The carbon project cycle requires upfront expenditures by the activity proponent to cover the validation and verification costs before credits can be issued and sold in the market. These costs for carbon project development include: the development of the concept according to the selected standards requirements including the full document development and data/evidence collection for both the PDD and Monitoring report, fees due to the carbon standard to start the process and achieve registration and issuance, cost of the third-party auditors for validation and verification (as well as potential needs to revise the documents or gather additional revenues if requested by the VVB or the carbon standard) and issuance fees to be paid to the carbon standard for each credit issued. This is an important aspect, as the costs are borne upfront, while new revenues from carbon credits sale can be generated only after successful registration and issuance of credits, which is likely to take (from concept development to credits issuance) around one year but it could also extend up to two years (subject to several variables during validation, verification, and activity operations). In addition, other elements need to be considered, such as the timeline for activity implementation and actual plan for the dissemination of the vehicles, which will influence the volume and timing of the carbon credits issuance (and associated revenues). As mentioned, a monitoring period generally covers around 12 months of operations, but there is no mandatory rule and different timeframes can be used.

Building on the outlined carbon crediting cycle process and associated requirements above, cost estimates can be provided for each step. As mentioned, purchase agreements between the activity proponent and credit buyer(s) can be structured in several manners. This means that parties can agree according to their preference: for example, the possibility to include upfront (partial) payments to the activity proponent to cover the carbon cycle costs, if the buyer agrees. The table below shows the costs for large- and small-scale activities. GS provides simplified procedures for micro scale activities that are described in Box 3.

Table 4: Registration and issuance under GS and VCS and associated costs, USD[11]

GS		VCS
Activity development		
Concept development, document preparation, evidence collection, support during validation	50,000-100,000[12]	
Account opening fee	1,000 annually (per account) USD 2,500 (only in case of reactivation)	500 one-offs 500 annual maintenance
Preliminary review	900 per project	1000 (Pipeline listing request fee)
Validation		
Project design review	0.15 per credit minus preliminary review fee (upon submission for registration)	
Validation fee[13]	20,000-40,000	20,000-35,000
Registration		
Registration	Paid through the Project design review	2,500 (project registration request review fee)
Verification		
Document preparation, evidence collection, support during verification	25,000-50,000[14]	
Verification fee[15]	15,000-30,000	15,000-25,000
Performance Review	1,000 (per project)	Not applicable
Issuance		

[11] Actual cost shall be confirmed with the VVB based on the final activity design, size and scope .Validation, registration, verification and issuance costs presented in this report do not include the costs for the development of the activity design, document preparations, supporting evidence collection, interactions with VVB and standard during registration and verification processes. Activity proponents may choose to be supported by external companies specialized in the provision of technical and regulatory support throughout the entire carbon cycle until credits issuance. These services cover the document preparation, application of the selected methodology, interactions with VVB and carbon standard, evidence collection, processing of MRV data, etc.
[12] Validation under GS and thus the preparatory work is expected to be slightly more expensive for GS given the more robust reporting on SD contributions as well as mandated by the standard (this assumes that under the VCS options the SDVista is not applied). See table 5
[13] This value is only indicative and depends on the actual third-party auditor contracted, as well as on the activity location, complexity and overall scale, thus this value may vary in real life.
[14] Verification under GS and thus the preparatory work is expected to be slightly more expensive for GS given the more robust reporting on SD contributions as well as mandated by the standard (this assumes that under the VCS options the SDVista is not applied). See Table 5
[15] This value is only indicative and depends on the actual third-party auditor contracted, as well as on the activity location, complexity and overall scale, thus this value may vary in real life.

GS		VCS
Issuance Fees	First issuance 0.15 per credit minus Performance Review fee paid Subsequent issuances 0.30 per credit minus Performance Review fee paid Or 0.1 per credit + 2% credits (ex-post requested) minus Performance Review Fee	0.2 per credit, payable at the time of the issuance request

Source: Authors' elaboration based on GS 2023; Verra 2023

In addition to the costs listed in the table above, if a grouped project is implemented, sufficient staff and resources should be considered to ensure the overall activity supervision and coordination during implementation, as well as engaging with relevant stakeholders and manage contractual agreements.
It is important also to consider the cost needed to develop the PDD and gather the required information and evidence, as well as the resources needed to engage with the VVB during the validation process, that may require revision the documents as well as collecting and providing new evidence, if required by the VVB or by the standard operator. During this process, if the competences and resources are not available internally, it is possible for the activity developer to seek support from specialized consultancy companies that can help along the entire process (document development and meeting standards requirement, liaison with the VVB and the standard operator, etc.). This additional cost varies depending on several factors, such as the activity being a project or a program, complexity of the activity, etc. An indicative price range is provided here[16] and it ranges between 50,000 and 100,000 USD for the full support, including preliminary work, development of the concept, full documents preparation, collection of evidence and engagement during the validation with the VVB and the standards until successful registration. Similarly, the cost for the monitoring and verification of the performance of the activity shall be considered. Also in this case the activity developer can seek support from specialized companies in the preparation of the MRV system, development of the required documents and evidence, support throughout the verification and issuance process managing the relationship with the VVB and the standard. A total cost ranging between USD 25,000-35,000 should be considered.

The following table summarizes the main costs for the validation and verification processes under the GS and VCS[17]. It assumes one VPA inclusion and one issuance.

Table 5: Summary of costs for validation and verification under GS and VCS

Item/standard	VCS	GS
Validation costs		
Preparatory work, document development	75,000	83,000
Standard's costs (opening of account, design review, etc.)	2,000	1,900
Fee for submission for registration	2,500	Variable
Validation fees	25,000	33,000
Total validation	**104,500**	**117,900**
Verification cost		
Preparatory work, document development	25,000	30,000
Standard's costs (review, verification fees, etc.)	NA	1,000
Verification cost	15,000	18,000
Issuance fee	Variable	Variable
Total verification cost	**40,000**	**49,000**

[16] The actual cost of these activities shall be confirmed during the actual activity development.

[17] The estimates for VCS do not include the cost for the SDVista certification (optional)

Item/standard	VCS	GS
Total cost validation + verification (not including variable fees)	**144,500**	**166,900**

Source: Authors' elaboration based on GS 2023, Verra 2023

Box 3: Simplified procedures for micro-scale activities under GS

The GS defines micro-scale activities as activities that reduces less than 10,000 tCO_2eq/year. In this case (both for stand-alone projects and programmes proponents can choose whether hiring a VVB or applying for the Internal Validation Option. In this case, the proponent pays a fee to the Validation and Verification Fund, which then covers the cost for the validation of verification of the activity (GS 2019b). GS can either validate the activity internally or use an external VVB, in both cases the fund covers the costs. Support from the Gold Standard Validation Fund is subject to the availability of funds (GS 2019b).

Figure 3: Fees for micro scale activities under the GS

Step	Cost (USD)
Standalone – Validation Fee	5,000 per project
Standalone – Annual Verification Fee	2,500 per project per year
Programme – Validation (including 1 VPA)	22,500 per programme
Programme – Inclusion/Validation Fee	2,500 per additional VPA
Programme – Annual Verification Fee	1,500 per VPA

Source: GS 2023

The variable costs for registration and issuance are the same as under the fee schedule for non-mi activities. In addition, micro scale projects can benefit from lower fees (to be paid to GS) also for the following steps:

- Preliminary review 500 USD (instead of 900 USD)
- Performance review 650 USD (instead of 1,000 USD)

This option may be more appealing for proponents that already have a clear dissemination plan for their e-motorbikes and the resulting emission reductions are within the 10,000 tCO_2e per year and thus reduce the costs for completing the different steps to generate carbon credits. It is fair to assume, however, that companies aiming at the dissemination of electric motorbikes have more ambitious dissemination plans and thus this option may not be the most suitable to maximize carbon revenues.

2.5. SDG reporting

In the past few years, rising importance has been given to the impacts of activities that go beyond the mitigation potential. This indicates the interest from proponents and buyers on activities that reduce GHG emissions (or remove them), but also other positive (and avoidance of potentially negative) impacts that the activities may generate from a broader socio-economic and environmental perspective. The United Nations defined a set of 17 sustainable development goals (SDGs) to be achieved, which are shown in the following figure.

Figure 3: The UN SDGs

Source: UN n.d.

In terms of sustainable development (SD) contributions, VCS and GS have different approaches. For GS, the reporting on SD contributions is embedded in the standard. The format for reporting on SDG contributions under GS is rigidly designed so that activity proponents must report their impacts under the indicators defined by the UN with defined monitoring units. The user chooses an SDG or impact category and is then given the monitoring frequency, unit, and exact indicator to use based on the SDG chosen. This standardised template allows clear comparison and assessment between activities. GS's SDG monitoring and reporting is a mandatory requirement, and the monitored SDG impacts are verified as part of the verification of the activity's impacts. Safeguards against adverse impacts are also included. This ensures a high level of integrity beyond mitigation alone but is reflected in slightly higher transaction costs under the GS. Carbon credits that have a clear approach to SD contributions through monitoring and reporting benefit from a higher market price (see Section 4). Use of high-quality credits where the mitigation component is paired with robust SD contributions and safeguards for potential adverse impacts is likely to reduce reputational risks, for instance when voluntarily offsetting emissions.

VCS provides some flexibility in the reporting compared to the GS. VCS requires activities to contribute to at least three SDGs in each monitoring period and requires the monitoring of impacts, but not their verification. Under this model, contributions are reviewed by Verra staff during verification to ensure that all relevant information is reported, and evidence provided. However, contributions are not formally verified, and the process allows less complex MRV procedures, therefore the SD contributions may not be as highly valued as the GS's more rigorous approach. Verra provides another standard to certify the SD contributions, the CCB: however, this standard is applicable to land use-related activities, and it is not relevant for e-mobility activities.

Activity proponents wishing to certify their SD contributions under Verra have the option of using the Sustainable Development Verified Impact Standard (SDVISta). This flexibility is due to the possibility of

tailoring a methodology for the MRV of the SD contribution freely, with support from Verra on methodological guidance. It also provides a registry to track all SDVISta activities, including on the emission reductions achieved. However, new methodologies will have to be reviewed and approved by Verra, with the associated development and validation costs. The robustness is ensued by the third-party verification of the actual impacts. SDVISta sets requirements for activities that aim to generate SD benefits specifically on how to design, implement, and monitor the impact. The following figure depicts the main components of SDVISta.

Figure 4: SDVISta main components

Source: Verra n.d.

The third-party verification represents a guarantee on the quality and robustness of the impacts monitored and reports by an activity. On the other hand, this process requires additional resources for the MRV, including collecting data that may not be directly available to the activity proponent, and for the external validation. Verra offers another option for SDVISta validation, i.e., being assessed by the independent expert evaluation. Overall, there are different fees that are due when applying for the SDVISta that total 9,000 USD, plus an issuance fee that is proportional to the volume of GHG emissions reduced, which is 0.05 USD per carbon credit up to one million credits (Verra 2019).

The selection of the approach to follow for reporting SD contribution can vary significantly from one activity type to another. Certain activities e.g., forestation and land use, may have very important negative impacts on indigenous people, relocation, biodiversity, and the risks are very strong. Other activities (energy efficiency and renewable energy, for instance) have impacts (beyond emission reductions) principally on the economic level and with potentially positive benefits.

In the case of e-motorbikes, the main SDG contributions generally focus on Climate Action (13), Sustainable cities and communities (11), Industry, Innovation, and infrastructure (9), and No Poverty (1). If the activity also includes the provision of clean energy for recharging the e-motorbikes, then it can also contribute to Clean and Affordable Energy (7). From a general perspective, there are no significant adverse impacts expected from a well-run activity for the dissemination of EVs. There is one aspect however, that deserves close attention as it may potentially result in dangerous impacts: **the battery disposal**. The activity

proponent needs to ensure that batteries (especially in cases where swap stations are planned and built) are disposed of in an environmentally sound manner at the end of their technical life. Batteries after 4-5 years may be replaced as their efficiency is lower and it may not suffice for a running an EV efficiently. However, after this initial life, the batteries can still be used as storage systems. Where possible, this can prolong a battery's life further. However, battery disposal shall be planned and designed accurately to ensure avoidance of contamination in the environment.

The decision on which SDG to report is made by the activity proponent based on the actual activity features: for instance, inclusion of rural areas may serve to increase access to mobility or provide enhanced income to boda drivers. Some activities may foresee the provision of renewable energy, others may specifically target women and/or social cooperatives. The level of complexity of the MRV in real life operations shall also be considered; some of the information (e.g., on gender equity, or other economic impact) may not be directly available to the activity proponent and even the EV users themselves, but engagement with relevant national stakeholders (e.g., statistical agencies) may be needed, and/or the potential for surveys to be conducted. There is no one size fits all solution, and the final decision should consider both the number of SDG goals that the activity intends to contribute to as well as the complexity of monitoring, reporting, and verifying them. Additionally, budget implications of the different approaches must be considered, including the potential need for external verification. The selection of the SDG reporting approach may also be guided by the claims one company intends to make on their SDG contribution: if the activity proponent puts strong emphasis on communicating its commitment and results towards SDG implementation, then a more robust approach that ensures full transparency and minimises any potential reputational risk might be preferred.

An overview of the differences between the SDG reporting templates can be seen in Table 6.

Table 6: Comparison of SDG contribution templates

	Gold Standard SDG Impact Tool	Verra Sustainable Development Contributions Report	SD VISta (Sustainable Development Verified Impact Standard)
Website	Background: https://globalgoals.goldstandard.org/430g-iq-sdg-impact-tool-manual/ Template: https://globalgoals.goldstandard.org/sdg-impact-tools/	Background: https://verra.org/sustainable-development-contributions-report-template-now-available/ Template: https://verra.org/wp-content/uploads/2020/07/Verra-SDG-Contributions-Report-Template-v1.docx	Background: https://verra.org/project/sd-vista/ Standard guide: https://verra.org/wp-content/uploads/2019/01/SD-VISta-Program-Guide-v1.0.pdf
Format	Excel-based tool with indicators and targets based on activity type, methodology, and sector	Word template with table for listing SDG indicators and activity contributions	Certification standard (does not include creation of carbon credits, but can be used concurrently with VCS)
Use case	Reporting template mandatory for all activities seeking certification after March 2022. Meant for use by all activities, irrespective of scope or scale. Third party verification is required.	Template allowing activities to self-report SDG contributions, which must be submitted with MRV report (contributing to at least 3 SDGs)	For activities that wish to report verified contributions to SDGs (incl. VCS projects that wish to label their VCUs with these specific sustainable development contributions). Activities must demonstrate to a third-party assessor that they advance the SDGs
Steps	Select activity type (drop-down list of five options) Select quantification method (impact category or specific SDGs) Select specific impact category or SDG Default monitoring indicators are given (ex: impact category = climate change mitigation, 2 possible monitoring categories are then given, e.g., amount of GHG emissions avoided or sequestered. Calculation method/unit, etc. is then given) Fill in activity assessment Max 10 monitoring indicators allowed SDG 13 (Climate action) is mandatory	Fill in table listing relevant SDG indicators and the activity's contributions Provide evidence as separate attachments or in activity documents Example summaries of SD contributions are included in another appendix (1 paragraph each)	Activity description submitted to Verra Independent assessment (including on-site visit) VCUs then bear an SD VISta Label in the Verra registry

Assessment	Proponents must use the indicators defined by GS. New indicators can be proposed with a template but will then only be included in the next iteration of the tool. A clearer process for definition of indicators, calculation methods and units allow for comparability across projects and indicates a more robust framework.	Less structured and more flexible. Self-defined measures for tracking a benefit that do not align with an official SDG indicator can be included with the user-defined indicator. This flexibility can be beneficial for activity proponents looking to design their own calculation methods and report on indicators not expressly included in the SDG indicator list, though a lack of consistency may be perceived as a lack of robustness.	In-depth framework. Methodology would have to be developed for electric vehicle activities. Currently, only methodologies for cookstoves and wetland restoration exist. However, SD VISta allows activity proponents wishing to design activities under Verra to certify SD contributions, enhancing trust from buyers.

Sources: Gold Standard n.d.; Gold Standard 2019a, Verra n.d., Verra 2020

3. Comparison of applicable methodologies

There are several baseline and monitoring methodologies that are applicable to the transport sector, including under the CDM and VCS. VCS and GS have a list of their own methodologies, but GS does not have a specific methodology applicable to e-mobility whereas VCS has a specific methodology, VM0038, that fits e-mobility.

The CDM is the largest source of methodologies and are accepted by both the VCS and GS, giving activity proponents more options and avoid having to develop new methodologies. CDM methodologies are deemed robust as many have already been tested in real life for thousands of activities and undergone several rounds of revisions[18]. There are independent standards that set their own methodological approaches: however, the credibility of the standard and its rigour on methodology development and approval is important as this may result in reputational and financial risks associated with the carbon credits. Thus, it is strongly suggested to always select a robust methodology under a reputable standard to avoid potential risks of utilizing questionable approaches to generate carbon credits. Table 7 presents a comparison of available monitoring methodologies that can be applied to the dissemination and operation of new electric motorbikes in Uganda. Applicable methodologies have been identified under the CDM and the VCS.

[18] CDM methodologies are collected in the Methodology Booklet, a comprehensive guide giving an overview of all current CDM methodologies, categorised by mitigation activity type and sector. The CDM Methodology Booklet is available at https://cdm.unfccc.int/methodologies/documentation/meth_booklet.pdf

Table 7. Comparative analysis of available CDM and VCS monitoring methodologies suitable for e-motorbikes

	Title	Scope and applicability criteria	Applicability to e-motorbikes
VCS	**VM0038 Methodology for Electric Vehicle Charging Systems**	Applicable to charging of EVs through EV charging systems: • Battery Electric Vehicle and Plug-in Hybrid Electric Vehicle for L1 and L2 chargers • BEVs for direct current fast Chargers for light duty vehicles activities. Electric medium duty vehicles and Heavy-duty vehicles eligible to charge at the project's set of EV chargers.	Applicable, focuses on the charging stations.
CDM	**AMS-III.C. Emission reductions by electric and hybrid vehicles**	Applicable to activities introducing new electric and/or hybrid vehicles that displace the use of fossil fuel vehicles in passenger and freight transportation. Applicable to hybrid/EVs (not limited to) cars, buses, trucks, jeepneys, commuter vans, taxis, motorcycles, and tricycles.	Applicable
	AMS-III.S. Introduction of low-emission vehicles/technologies to commercial vehicle fleets	Introduction and operation of new less-greenhouse gases (GHG)-emitting vehicles for commercial passengers and freight transport, operating on routes with comparable conditions. Retrofitting of existing vehicles is also applicable. Applicable to: Buses, jeepneys, commuter vans and tricycles for public transport; trucks for freight transport, waste collection or other services with regular routes.	Applicable
	AMS-III.BM. Lightweight two and three wheeled personal transportation	Applicable to activities introducing e-bikes or tricycles (such as e-bikes belonging to a bicycle sharing programmes or promotion of individual ownership).	Not applicable, only covers e-bicycles or tricycles
	AMS-III.AA Transportation Energy Efficiency Activities using Retrofit Technologies	Applicable to activities performing engine retrofit of existing/used vehicles for commercial passenger transport resulting in increased fuel efficiency of the vehicle.	Not applicable, the focus is new vehicles
	AMS-III.BC. Emission reductions through improved efficiency of vehicle fleets	Applicable to activities that improve the efficiency of vehicle fleets, resulting in reduced fuel usage and greenhouse gas emissions. Applicable to fleets of trucks, buses, cars, taxis, or motorized tricycles.	Not applicable, the focus is on efficiency increases, rather than on new electric motorbikes

Source: Authors elaboration based on UNFCCC 2021, VCS 2018

The comparison above shows that there are several methodologies that are applicable to the dissemination of e-motorbikes**. The most relevant ones are AMS-III.S., AMS-III.C. and the VM0038**.

Under **VM0038**, additionality is automatically demonstrated, provided that the activity is located in one of the countries pre-identified. Currently, no east African country is included in the list, though. Alternatively, additionality would have to be demonstrated utilising other options, or the module that defines the conditions (and countries) under which the activity is automatically additional would have to be revised.

AMS-III.C. provides some flexibility with the possibility of calculating the emission reductions achieved utilizing either the distance travelled by the activity vehicles, or the electricity consumed. This gives the possibility to cover different types of activities, such as pure dissemination of e-motorbikes to users that re-charge the motorbikes privately or to activities that aim to introduce centralised charging stations and swap stations. It also provides the option to demonstrate additionality through the penetration rate as long as the activity vehicle type does not reach 2.5% "of the annual sales of the vehicles of the same category in the region "(CDM 2022).

Methodologies must be selected considering the actual design elements of the underlying activity to ensure that applicability conditions are met. As discussed, baseline identification and demonstration of additionality are key steps, as well as the early consideration of the MRV system design and implementation that are required to define a robust activity that can pass validation and once registered, issue carbon credits.

4. The VCM and Article 6

4.1. Current market situation

Overall, current average prices for issued credits under the GS and VCS are similar. The weighted average price in the carbon markets at the end of 2021 was 4 USD/ tCO_2e (D'Onofrio et al. 2022). GS certified units in 2021 reached 5.05 USD t/CO_2e (D'Onofrio et al. 2022). Regarding the VCS, average prices were also above market average for activities that have a certification on social and environmental co-benefits: units labelled with the Climate, Community and Biodiversity Standard (CCB)[19] yielded 5.05 USD/ tCO_2e, while activities using the SD Vista averaged 4.43 USD/tCO_2e (D'Onofrio et al. 2022). For all these cases, an increase in volume and price has been witnessed from 2021[20]. However, these prices may not be fully reflective of the price that carbon credits from transport activities may reach in the market. Activities in the transport sector generated five times more credits in 2021 than in the previous year, reaching 5.4 million t/CO_2e, but prices only increased (on average) from 0.64 up to1.16 USD/ tCO_2e (D'Onofrio et al. 2022). It is important to highlight that most activities in the transport sector are so far led by public transport activities and CDM activities (D'Onofrio et al. 2022). The following figure shows the total volume of the VCM.

[19] The CCB is applicable to land use-related activities.

[20] For more details on the sustainable development contribution reporting under VCS and GS, please see next section.

Figure 5: VCM size by traded value (pre-2005/2021)

Source: D'Onofrio et al. 2022

Prices for EV activities under VCS and GS are not public. As of July 2023, 15 activities have been registered in the transport sector, with six activities implementing e-mobility measures at different locations (VCS 2022b). Under GS, no activity has been registered focusing on e-mobility yet sector, although several new activities are being listed in the pipeline[21], (GS 2022c). This shows that the e-mobility sub-sector is not yet benefitting from carbon market support on a large scale. It is worth noting that under bilateral cooperation agreements between Switzerland and Thailand, the KliK Foundation signed its first MO purchase agreement from an e-mobility activity in Thailand (implemented by the Energy Absolute Public Company Ltd) aiming at introducing electric buses (KliK n.d.). This indicates an interest from compliance buyers on credits from e-mobility as the sector is increasing in importance in many countries.

4.2. The role and impacts of Article 6

The Paris Agreement's Article 6 defines three modalities for voluntary cooperation between countries to contribute to the achievement of the NDCs and allow for higher ambition while promoting sustainable development and ensuring environmental integrity.

- **Article 6.2 governing bilateral/multilateral cooperative approaches between Parties.** Under Article 6.2, Parties can authorise transfers of mitigation outcomes (MO) to become 'internationally transferred mitigation outcomes' (ITMOs). The authorisation is given for uses against other Party's NDCs for international mitigation purposes (e.g., CORSIA) and for other purposes (e.g., VCM). If a MO is authorised and transferred, it must be accounted through the corresponding adjustments (CA). This provision aims at ensuring environmental integrity and avoids double counting.

[21] Including also shipping and public transport systems like metro systems.

- **Article 6.4 establishes a baseline-and-credit mechanism** under a Supervisory Body that can approve the issuance of MOs. If authorised by the host country, these MOs can also become ITMOs under the Article 6.2 guidance. This mechanism closely resembles the CDM.
- **Non-market-based approaches** under Article 6.8[22].

CA are an accounting procedure that aim to avoid double claiming of ITMOs under Article 6. The transferring (host) party applies CA to all authorised ITMOs adding to its emissions balance an equivalent amount to the ITMOs authorised. The buyer applies CA if the ITMOs are used against its NDC, deducting from its emissions balance an amount equivalent of ITMOs. In the case that the ITMO is used for international mitigation purposes or other purposes, a buyer country's CA is not applicable.

It is important to highlight that Article 6 rules do not have any direct impact on the VCM, meaning that they do not apply to the VCM. However, they set a standard for high integrity which is likely to impact the VCM as well. Even if the requirements on authorisation and CA are not mandatory, voluntary buyers interested in environmental integrity and high-quality credits may follow the requirements of Article 6. There is an emerging trend in differentiating between MOs that receive a CA and those that do not; some standards are already looking at differentiating between the two (Verra 2021). Other entities, such as GS, support alignment of VCM with the Paris Agreement and will be rolling out new requirements for CA over time. Conditions for alternative claims for credits without CA will also require new conditions, however acknowledging the complexity of the CA process for activity proponents (GS 2022d). It can be expected that MOs with a CA will yield a higher price on the market compared to those without a CA. However, the debate on this point is still evolving.

In this context, the role of host countries becomes more relevant than in the past. As all Parties have a mitigation target in their NDC, national authorities need to monitor potential international transfers to/from other countries to track NDC implementation. Overselling MOs abroad may jeopardize the NDC achievement (with NDCs mandated to become more ambitious over time), and bear a risk on price, as MOs may increase their value in the short/mid-term. Host countries may therefore need more MOs for implementing the NDC and as a result international trade may be restricted. This will become more relevant as NDCs become more ambitious and if Parties implement more stringent policies on emissions at domestic level. Procedures for performing the CA are still awaited. In addition, countries need to fully understand where they stand with their NDC implementation, and whether sales of ITMOs may lead to non-compliance and missing the mitigation targets. There are cases of countries that are not yet willing to allow transfers of ITMOs abroad until they have a more accurate understanding of the implications ITMO transfers will have on NDC implementation, as well as a complete set of rules under Article 6. This is currently slowing down activity implementation. In some cases, host countries have halted transfers of carbon credits as well as those for voluntary purposes from specific sectors (Carbon Pulse 2022a). Host countries will also have to authorize the activity and the transfer of the resulting ITMOs: while currently obtaining this approval is not required under VCS and GS, if the standards will align to Article 6 requirements, and especially on the CA,

[22] Article 6.8 approaches are not relevant for the purpose of this report and thus not considered further.

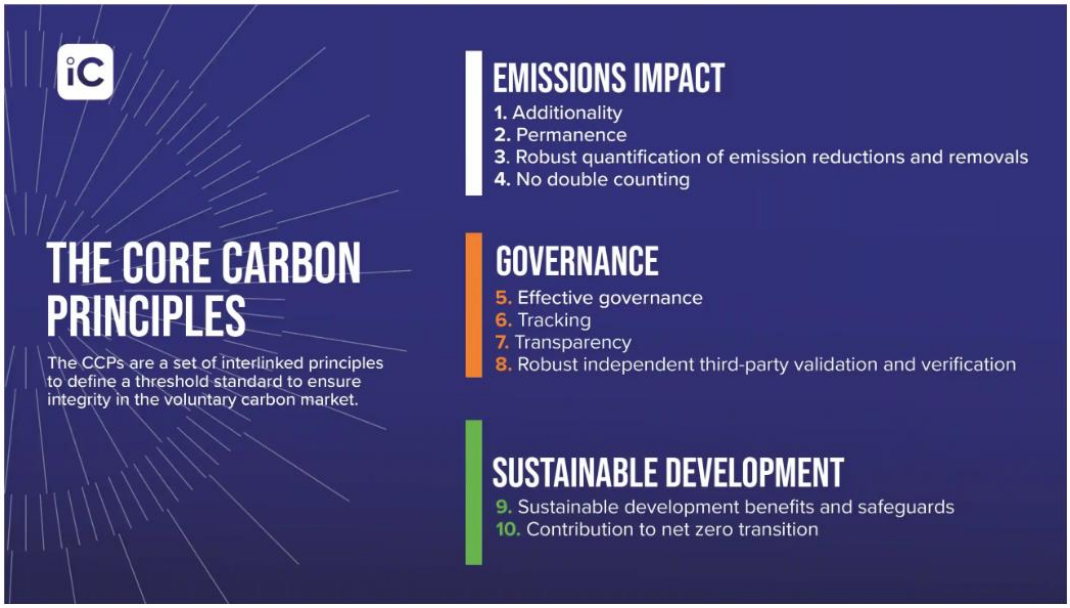
then it is likely that a similar approval is required also under the voluntary standards, increasing the interactions between the activity proponent and the host country government.

4.3. Carbon credits quality

Numerous initiatives have been formed in recent years intending to contribute to the integrity of VCM and prevent dishonest use of claims and investment in activities that do not truly bring additional mitigation benefits. There is no entity or authority that governs the VCM and that can define unequivocally what requirements a carbon credit must meet to be considered high-quality, nor on the evaluation of the legitimacy of the claims made by companies using the carbon credits. However, of the many initiatives that attempt to provide guidance in the sector, one of the most prominent is the Integrity Council for the Voluntary Carbon Market (IC-VCM).

The Integrity Council for the Voluntary Carbon Market (ICVCM) has developed criteria and frameworks for assessing and promoting carbon credit quality by issuing labels to carbon credits that meet its Core Carbon Principles (CCPs) (ICVCM 2023). The principles aim at evaluating whether both the carbon credits and the crediting standard reach high quality. In addition there is one criterion that goes beyond carbon credit quality and aims ensuring a contribution to the new zero transition. The set of principles is summarized in the figure below.

Figure 4: Core carbon principles from IC-VCM



Source: IC-VCM 2023

Also the Carbon Credit Quality Initiative (CCQI) aims at the promotion of a set of criteria to ensure carbon credit quality. It provides an online scoring tool that allows the assessment of the carbon credit quality (CCQI 2023). In common with IC-VCM, also CCQI sets criteria to ensure a minimum quality level as well as for contributing to the transition towards net zero emissions by avoiding lock-in of carbon intensive technologies or practices. Furthermore, CCQI introduces another quality criteria, i.e. the 'host country ambition': this

criterion serves to avoid providing a perverse incentive for countries to engage with the carbon markets for selling carbon credits, while jeopardizing the achievement of its own NDC target to maximize revenues for the markets (CCQI 2022).
These principles are seen by many as a step forward in promoting integrity in the VCM and enhancing trust in the impact of carbon crediting activities. However, as the CCPs have been published only recently their actual implementation and the level of engagement of actors in the market with the CCP remains to be seen.

5. Key Findings

Overall, activity design and methodology selection are crucial steps before starting the carbon cycle for credits generation. The key design features of the underlying activity may affect the methodology applicability and will also guide the activity implemented on the decision whether to implement a grouped project or a stand-alone project. For the dissemination of e-motorbikes, the grouped project seems to be the most suitable approach considering the substantial number of vehicles to be disseminated and the phased approach to their introduction in the market.

Several methodologies are applicable for EV activities under the CDM and VCS. Eligibility must be thoroughly assessed, after which the main elements (additionality, baseline, MRV and quantification of the mitigation impact) are to be addressed Both standards and GS both standards accept CDM methodologies and allow the development of grouped projects: thus, these components are not necessarily conclusive on the standard selection. A preliminary assessment shows that AMS-III.C. offers a sufficiently flexible approach to the mitigation estimate calculation, as well as providing two options for additional demonstration. The latter can be demonstrated using the penetration rate (now down to a maximum of 2.5% compared to the 5% in the previous version of the methodology) give the very low market shares for new sales of EVs. This window of opportunity, however, may close soon, as several companies are now aiming at disseminating e-motorbikes in African countries, including local vehicle producers. If this option is not viable, then the financial additionality shall be demonstrated which may be more challenging. Overall e-vehicles have a lower total cost of ownership compared to ICE vehicles. The inclusion of the charging infrastructure (if this is the case) and of the associated costs may result in e-vehicles being more expensive than ICE.

The selection of the carbon standard should consider the process for achieving registration and credits' issuance, and the associated costs: requirements on SDG reporting and how these can be realistically implemented within the activity. The decision shall thus be made only when the above elements are fully clarified. GS and Verra are the most prominent carbon standards in the voluntary market. The two standards have similar project cycles for registration and issuance of carbon credits, but differ in their treatment of SDG reporting, principles on Paris Agreement alignment, views on integrity principles, as well as registration costs. Registering an activity under either VCS and GS may cost between approx. USD 145,000 and USD 167,000 respectively[23]. These costs will be borne upfront by the project developer and are necessary to

[23] The price provided for VCS does not include the potential certification of the SGD impacts through the SDVista.

achieve credit issuance and to generate revenues from the sale of the carbon credits. To cover this additional cost for the developers, the amount of emissions reductions and thus of motorbikes would be required. Initial estimates based on actual data from the e-motorbikes indicate a potential mitigation of almost 1.4 tCO_2e/year per e-motorbike. These estimates are based on actual data provided from a e-mobility provider active in Uganda that monitored from remote (smart batteries) the performance of 20 e-motorbikes for six months (yearly values have been estimated) in Kampala. Thus, there could be differences in the values provided below depending on the key factors (e.g. electricity consumption of e-vehicles, total length driven per day/year, and even potential errors in the data recording, etc.).

Three different price levels are used to generate different scenarios and the total volume of e-motorbikes that would be needed to cover both the validation and verification costs as shown in the following table. The price assumed are: USD 2 for the low-price scenario, USD 7 for the Mid price scenario and USD 15 for the High price scenario.

Table 8: estimated number of e-vehicles required to cover transaction costs[24]

Price scenario	Number of vehicles required	Total emission reductions required (tCO_2e)
VCS		
Low	52,139	72,250
Mid	14,897	20,643
High	6,952	9,633
Gold Standard		
Low	60,222	83,450
Mid	17,206	23,843
High	8,030	11,127

Source: Authors' elaboration

As shown in the above table, when considering a mid-price scenario of USD 7, more than 20,000 tCO_2e would be required[25], thus a number of e-motorbikes ranging from approx. 15,000 to over 17,000 would be needed under VCS and GS respectively. The number is not very high, even though the specific context should be considered, such as the location and market potential, plans to develop the necessary recharging infrastructure, actual capacity of the proponent to introduce large number of motorbikes and the required production capacity, as well as the actual uptake amongst customers. This implies, however, that the activity developer has a sufficiently strong presence in the market, including production capacity and scale up plans. Sufficiently ambitious dissemination plans are often set out by e-mobility companies as part of their business model, and such volume of e-motorbikes in one VPA is not unrealistic[26] and once credits are generated (i.e. after one year operation) revenues would begin to flow. While a higher price would allow a fast recovery of the transaction costs, it is important to note that too low price (as USD 2 in the low-price scenario) implies

[24] The estimates do not include the registration and issuance fees that are variable, i.e. calculated on the volume of emission reductions estimated ex-ante (registration) or ex-post (issuance).

[25] Each credit is equal to 1 tCO_2e

[26] See for instance the grouped project in VCS pipeline n. 3985, which aims at the introduction of more than 67,000 e-motorbike in one VPA.

a rather large number of e-motorbikes required to recover the transaction costs, i.e. from above 52,000 to over 60,000, for VCS and GS. As seen in the VCM, credits with additional features, such as strong and demonstrated SD contributions, can fetch a higher price as buyers are willing to pay a price premium for credits perceived as of higher quality. Under the high price scenario of 15 USD/tCO_2, only approx. 8,000 e-vehicles (under GS) and almost 7,000 e-vehicles (under VCS) will be required.

It is important to highlight that these estimates consider that all transaction costs will be covered through the carbon credits generated through the first issuance only[27]. This means that every subsequent issuance that will be achieved by the program will generate additional revenues for the developer that can thus use them for other purposes other than covering the transaction costs. The generation of carbon credits could thus increase signidicnatly the profitability of the overall investment in e-mobility.

Once the first VPA is in place, it is expected also to benefit from a cost reduction from more expertise with the implementation of the overall program implementation, enhancement of capacity of the MRV, familiarity with the issuance process and associated evidence to be provided, economy of scales with the VVB, etc.

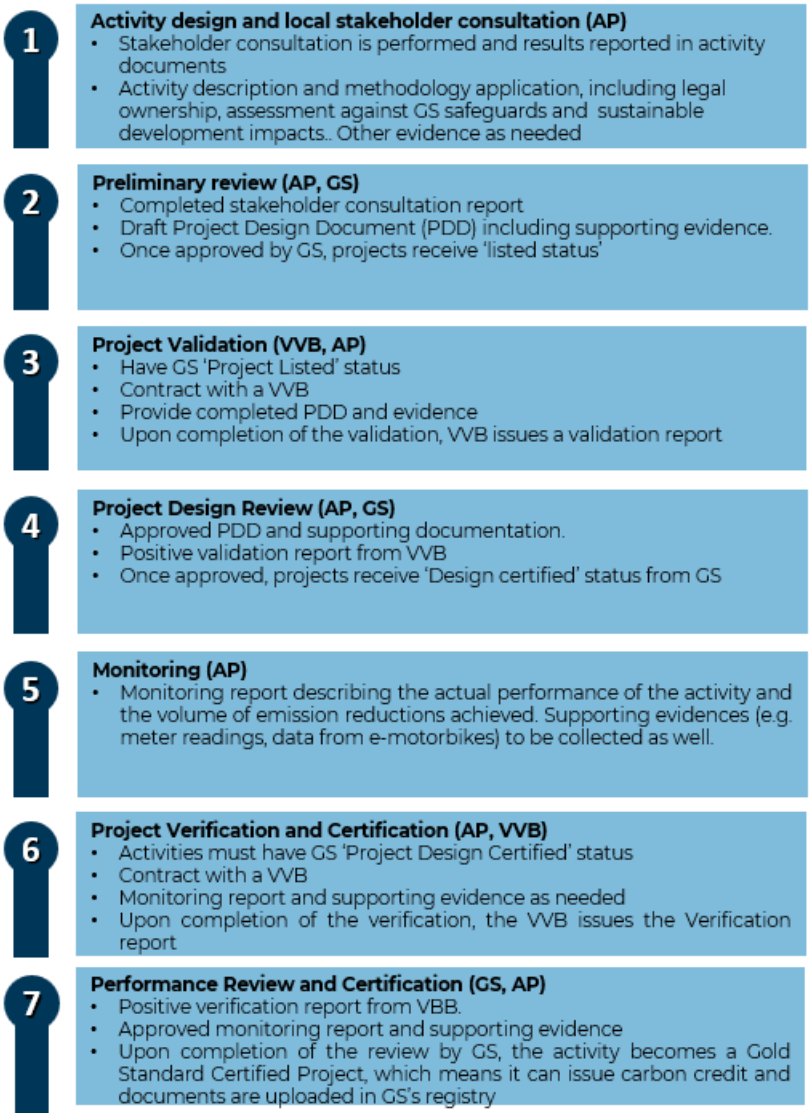
In conclusion, it is important to consider the timing for the disbursement to cover the transaction costs for the validation and verification process: however ambitious companies that have plans to introduce a sufficiently large number of e-motorbikes would be benefitting in the short term already (i.e. after the first issuance) as the associated revenues would exceed transaction costs very early in the technology lifetime. When considering expansion to other countries, the mitigation potential, and thus the volume of additional revenues would increase significantly providing further support to the scale up plans, although transaction costs may also increase.

This report does not focus on the interactions between Article 6 and the VCM, however the development of the Article 6 rules will likely influence the VCM and thus activity implementers should be abreast of these developments and assess how they could impact their carbon activity and ensure that their strategy also considers these interactions, as they will become more relevant as Article 6 becomes fully operational. Voluntary buyers may follow Article 6 requirements as these are perceived as providing higher environmental integrity and yield a price premium in the market. However, the policy and regulatory framework for Article 6 is not fully defined yet and its implementation will require more time. For instance, full regulation for performing the CA is still awaited. Carbon standard's positions on whether CA are required or not also in the VCM are also a crucial element to be considered with GS supporting the alignment with the Paris Agreement requirements also under the VCM, as opposed to the approach from Verra that aims at differentiating credits with and without CA. The latter is important, as trends in the markets and buyers' preferences are likely to lead to different prices for carbon credits with CA against credits without CA.

[27] The estimates do not include the variable component of the costs, such as the issuance fee.

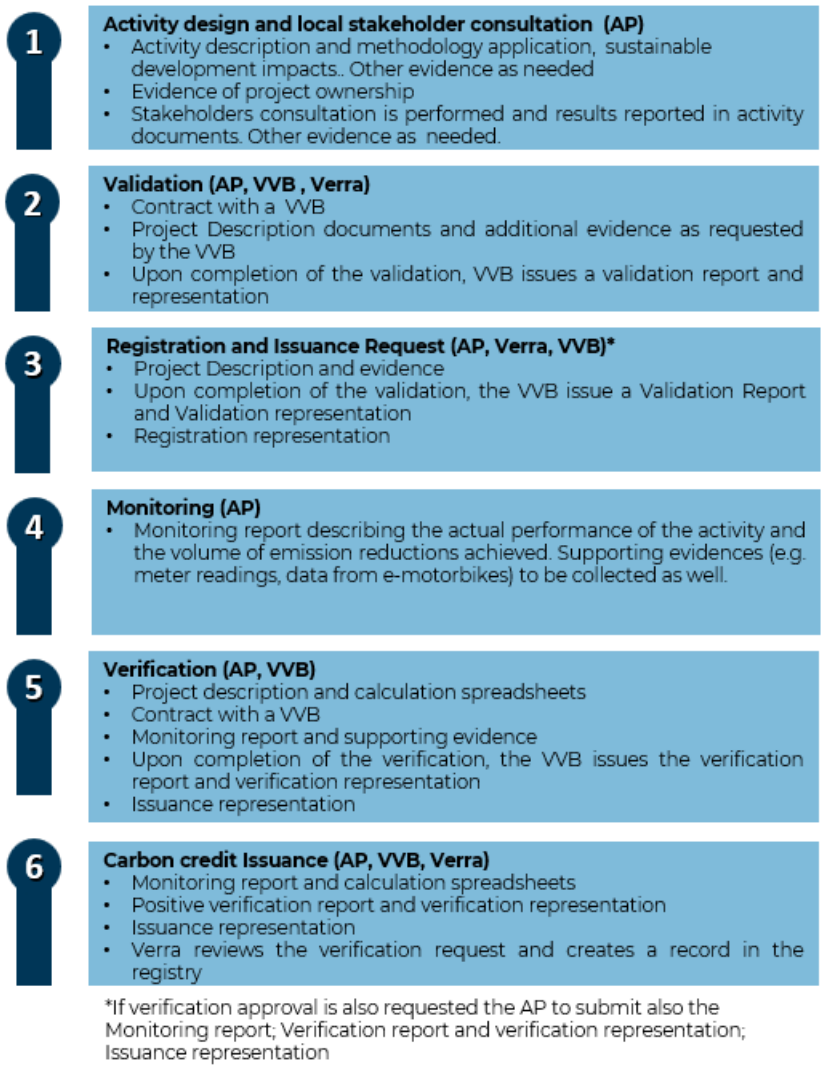
Annex I: Documents required for validation and verification under GS and VCS

Figure 5: Documents required for the activity validation and verification under GS



Source: Authors elaboration based on GS 2019a

Figure 6: Documents required for the activity validation and verification under VCS



Source: Authors elaboration based on VCS 2023

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