THE DEV CARBON STANDARD

2024 EDITION

DECENTRALIZED ENVIRONMENTAL VERIFICATION CARBON STANDARD

2024 EDITION

C MINDS

DEV STANDARDS FOUNDATION

SYSTEMS ENGINEERS FOR SUSTAINABILITY

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List of acronyms

DEV - Decentralized Environmental Verification.
RTD - Real Time Data.
NRTD - Near Real Time Data.
SE - Systems Engineering.
SI - Systems Integration.
SA - Systems Assurance.
MBSE - Model-Based Systems Engineering.
NIST - National Institute of Standards and Technology.
INCOSE - International Council on Systems Engineering.
NASA - National Aeronautics and Space Administration.
IEEE - Institute of Electrical and Electronics Engineers.
KPI - Key Performance Indicator.
AI - Artificial Intelligence.
ML - Machine Learning.
MRV - Measurement, Reporting and Verification.
ESG - Environmental Social Governance.
SDGs - Sustainable Development Goals.
GHG - Greenhouse Gases.
UN - United Nations.
UNFCCC - United Nations Framework Conference on Climate Change.
IPCC - Intergovernmental Panel on Climate Change.

ABOUT THE DEV CARBON STANDARD

Decentralized Environmental Verification (DEV) is a new environmental transparency model designed to provide accountability to sustainability projects and sustainability-related markets.

The DEV Carbon Standard is the world's first open data standard for carbon offset certification. It ensures the highest level of transparency by using Systems Engineering standards for the validation, verification, and certification of all the key actors for the offset creation. The DEV Carbon Standard makes it possible for any person with internet access to directly verify the Key Performance Indicators (KPI), the support data and the data sources behind the carbon offsets. It provides the framework for a truly decentralized verification of carbon solutions, whilst ensuring that the data being showcased is relevant, accurate, and reliable.

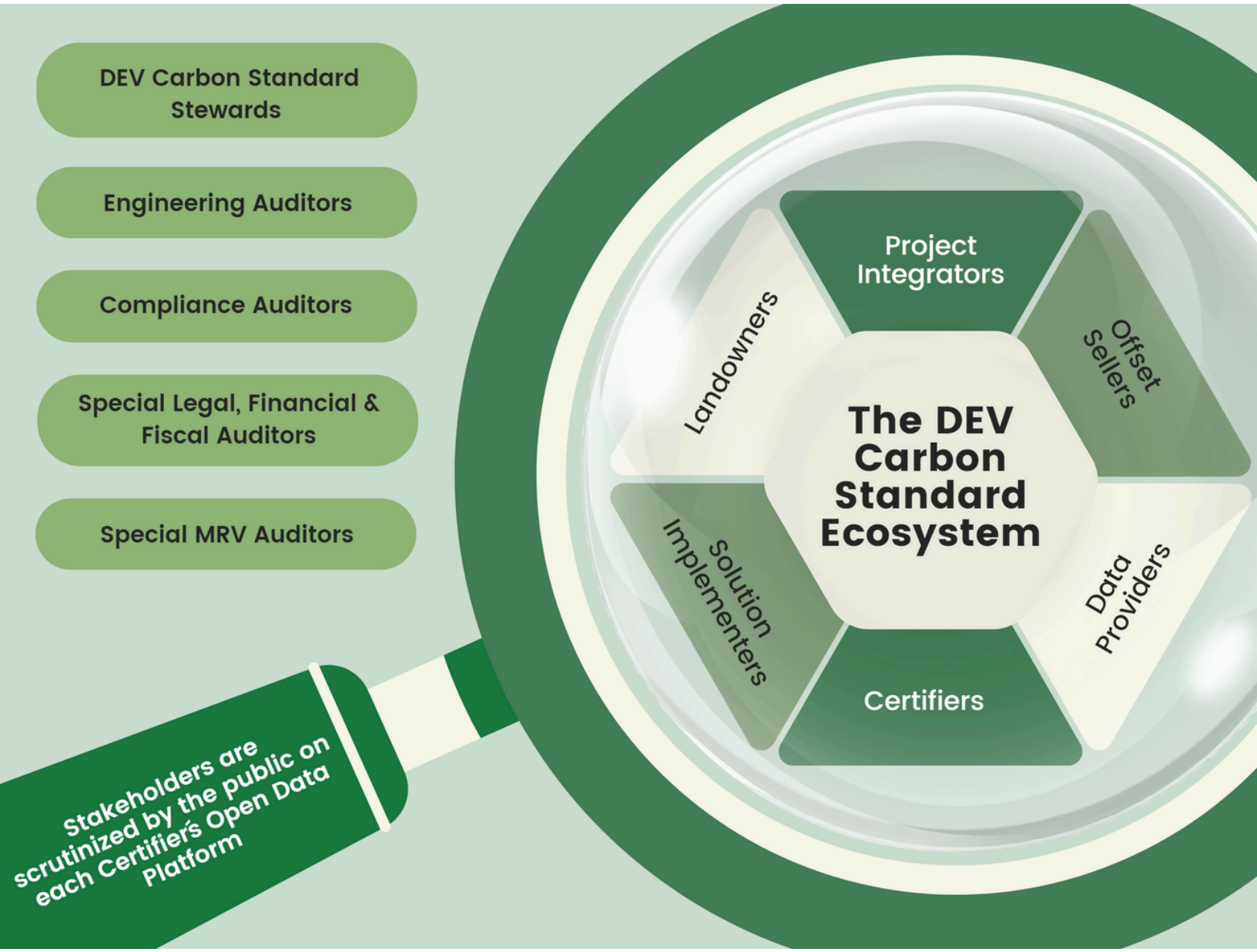
The DEV Carbon Standard is the first voluntary market standard where all stakeholders for offset creation, including the offset Certifiers, are audited against engineering standards. By using the DEV Carbon Standard to increase the transparency of the system, trust in voluntary offset markets can be rebuilt.

DETAILED FRAMEWORK OF THE STANDARD

The DEV Carbon Standard has two supporting documents for its implementation:

- The DEV Carbon Methodology. This document helps Project Integrators follow and apply the DEV Carbon Standard principles and guidelines in their proposed carbon solutions.
- The DEV Carbon Scientific, Technical, and Engineering Methodologies Framework. This is the detailed framework to understand in depth the DEV Carbon Methodology and the DEV Carbon Standard principles and guidelines.

THE KEY STAKEHOLDERS



The Stewards of the Standard. Foundations and technical partners that: (1) guard the text of the DEV Carbon Standard so if other entities try to modify it, there is always a way to know which is the current valid version, and (2) approve by consensus new Carbon Offset Certifiers and Engineering Auditors.

Data Systems & Systems Engineering Auditors. These Engineering Auditors approve and permanently audit the carbon solutions under state-of-the-art systems engineering and other engineering standards (ISO, INCOSE & IEEE, etc.). The data audit starts with the feasibility study, and once the carbon solution created by a Project Integrator is taken by a Certifier, the data quality audit becomes a permanent, year-round audit process of the carbon solution to ensure maximum transparency.

Project Integrators. These are organizations which design and develop carbon solutions. They bring together relevant actors for each new project: Landowners, Solution Implementers, a Certifier (which works with approved Data Providers), and the Offset Sellers (in case the Project Integrator needs external sellers). Project Integrators are approved by the Engineering Auditors.

Landowners. Landowners receive payments for the sale of carbon offsets from projects implemented on their properties. In clean energy projects this role is taken by the power plant owners / clean energy project owners; in the blue carbon projects it is usually taken by coastal communities with approval of the authorities with jurisdiction over the area. In the case of private property, the landowners pay for the feasibility study, and in the case of community or indigenous land it is usually project sponsors (companies that will get offsets from the project) who pay for the feasibility study.

Solution Implementers. These are providers of a specific solution for a carbon project (for example, reforestation, organic plant nutrients, soil restoration, regenerative agriculture, or a clean energy technology, or clean tech in general).

Certifiers. They certify the carbon offsets in alignment with the DEV Carbon Standard. They create and update an Open Data Platform where all KPIs, support data, and data sources (evidence), are made publicly available. Also, the final purchase of the offset certificates is always executed on the Data Platform, where Project Integrators upload, update and sell projects according to the guidelines that the Certifier establishes. Sellers & marketplaces promote the projects, and the purchase is completed always on the Project Integrator’s space on the platform.

Data Providers. Satellite, sensor, or data companies hired by the carbon solutions. They have to be approved on a case-by-case basis by the Engineering Auditors and / or the Certifiers. Because the Certifiers must publish certification data of every approved project, the data from the Data Providers must be reliable, relevant, accurate, valid, and verifiable.

Sellers. Sellers must ensure correct and accurate presentation of the carbon solutions to potential clients. They are appointed by the Project Integrators to help them promote their project portfolios. All sellers must have a commercial agreement with a licensed Project Integrator, so the Project Integrator is responsible for the Sellers it partners with.

Open Data Platforms. These are the digital platforms which showcase the KPIs, support data, and data sources behind every sealed offset. They allow data sharing to social media platforms to make decentralized verification easy and appealing. These platforms must be launched and maintained by each Certifier. Upon each project's approval, the Engineering Auditors establishes the required frequency of the data input to support each KPI, which could be Real Time Data (RTD), Near Real Time Data (NRTD), or another appropriate frequency agreed by the Engineering Auditors.

Compliance Auditors. Companies that are approved by the Certifiers to independently audit the Project Integrators and their carbon solutions on two levels: (1) the application and observance of: (a) the DEV Carbon Standard, (b) the DEV Carbon Standard Methodology, and (c) The DEV Carbon Standard Scientific, Technical, and Engineering Framework; and (2) the compliance with applicable local carbon offset regulations. Their compliance audit occurs at any time between the beginning of the Feasibility Study and the first six months of offset certification.

Special Financial, Legal & Fiscal Auditors. These are specialized legal, financial and fiscal compliance firms that are approved by the Certifiers to audit the administrative, financial, legal, and fiscal aspects of a carbon project. Their audits are assigned at entirely random times with a maximum frequency of one audit per carbon project every 12 months. Resulting scores and recommendations by these auditors will be immediately shared by the special auditor to both the audited Project Integrator and the relevant Certifier, giving the opportunity to the Project Integrator to immediately correct whatever was identified as unclear or non-compliant. Failure to correct any important aspect identified in the special audit without justification, would cause the Certifier to put offset certification on hold until the pending correction is complete.

Special MRV Auditors. These are companies are approved by the Certifiers to audit the Monitoring Reporting and Verification aspects of any Project Integrator and its carbon solutions at any time. These special MRV audits are assigned at entirely random times with a maximum frequency of one audit per carbon project every 12 months. Resulting scores and recommendations by these auditors will be immediately shared by the special auditor to both the audited Project Integrator and the relevant Certifier, giving the opportunity to the Project Integrator to immediately correct whatever was identified as unclear or non-compliant. Failure to correct any important aspect identified in the special audit without justification, would cause the Certifier to put offset certification on hold until the pending correction is complete.

THE AUDIT SYSTEM

There are 6 types of audits under the DEV Carbon Standard:

1. A feasibility study by the Engineering Auditors. It marks the beginning of any project.
2. A permanent data quality audit by the Engineering Auditors. This happens during the entire lifetime of the carbon solution.
3. A methodology and local regulation compliance audit, by the Compliance Auditors. This happens any time between the beginning of the feasibility study and up to six months into the offset certification.
4. An administrative, financial, legal and fiscal audit, by the Special Financial Auditors. This happens at random times, no more than once every year.
5. An Monitoring, Reporting and Verification audit, by the Special MRV Auditors. This happens at random times, no more than once every year.
6. The public scrutiny audit: as all offset data has to be published in an Open Data Platform, any person with internet access can choose to conduct an independent assessment of the relevance, validity, veracity, accuracy, and sufficiency of the data backing every offset certificate.

The system of checks and balances, besides the public eye via the Open Data Platform, works as follows:

1. The Stewards of the Standard approve the Engineering Auditors and the Certifiers.
2. The Engineering Auditors approve the Project Integrators, the Data Providers, the Solution Implementers, and the Offset Sellers.
3. The Compliance Auditors make sure offset creation and sale complies not only with the DEV Carbon Standard but also with applicable national and local regulations.
4. The Certifiers are obliged to publish all offset data (for public scrutiny) and are themselves audited by the Engineering Auditors. Certifiers have to approve the Compliance Auditors, the Special Financial, Legal & Fiscal Auditors, and the Special MRV Auditors, which in turn audit all carbon solutions at random times.

THE CARBON SOLUTION CERTIFICATION PROCESS

1 The integrator designs the carbon solution and brings together the Landowner and the Solution Implementers.

2 The feasibility study is executed by an Engineering Auditor. The study establishes (1) the project's legal, technical, methodological, and data engineering viability, (2) the baseline, (3) the carbon sequestration / avoidance potential, and (4) the project's MRV requirements. An additional compliance audit will be implemented by the Compliance Auditor any time between the beginning of the feasibility study and the first 6 months of offset certification.

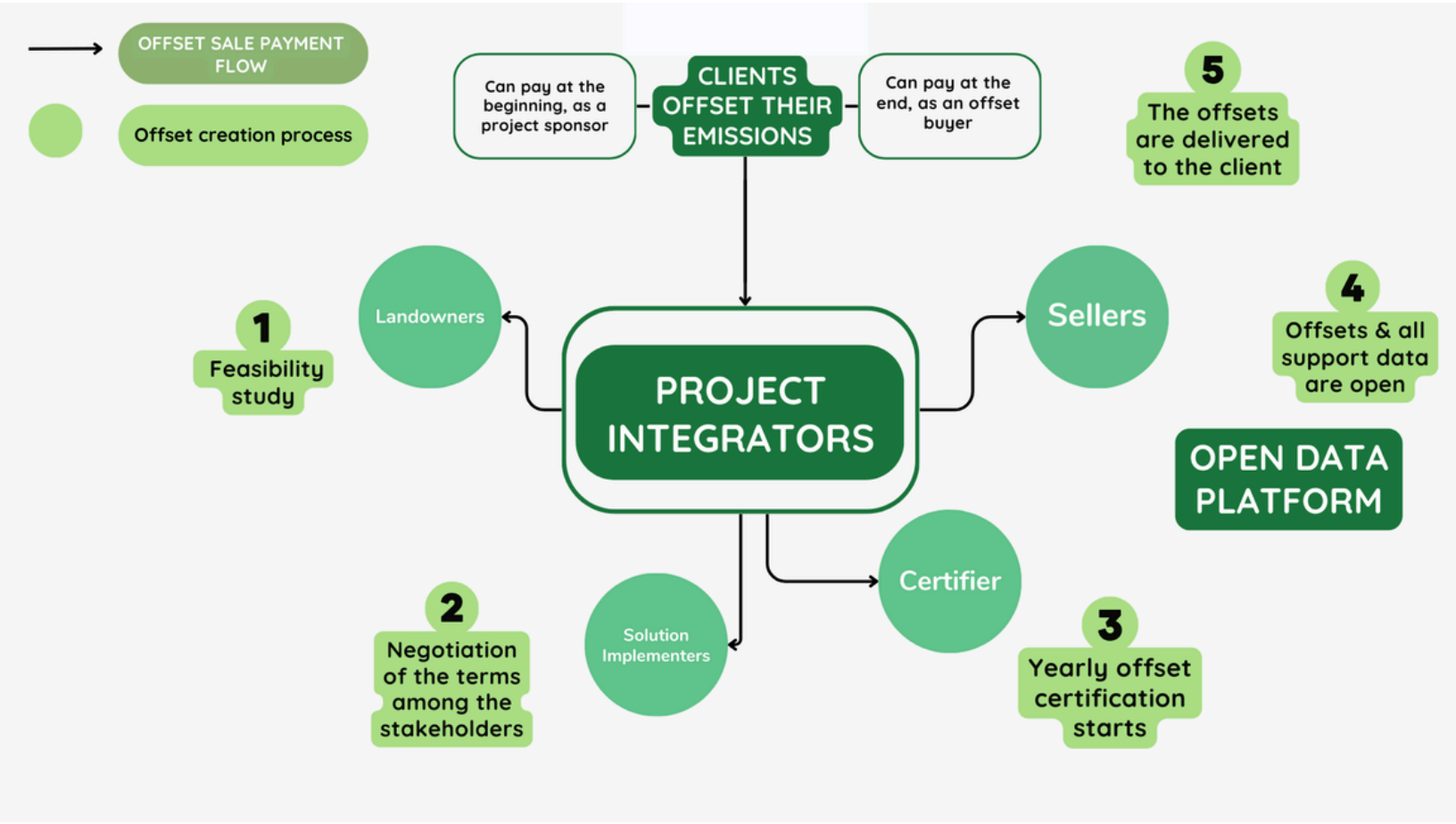
3 Once the Auditor declared a project feasible, and provided with a carbon capture estimate, the Integrator will fine-tune the project budget, and negotiate percentages for income distribution with stakeholders. The contracts are signed, ensuring a balanced and fair distribution.

4 A Certifier starts certifying the carbon offsets. The offsets and the support data are made available to the public on the Open Data Platform. The Certifier may send other 2 types special auditors anytime to audit the project: (1) the Special Financial, Legal and Fiscal Auditor, and (2) the Special MRV Auditor.

5 The Integrator (or another seller) sells the resulting offsets to buyers.
In the case of sponsored projects, the offsets are transferred to the project sponsor.

6 The client receives the offsets and the supporting links to all open source data evidencing their offset purchase. The client may use the open data for marketing materials and reports.

THE PROCESS VIEWED FROM ANOTHER PERSPECTIVE



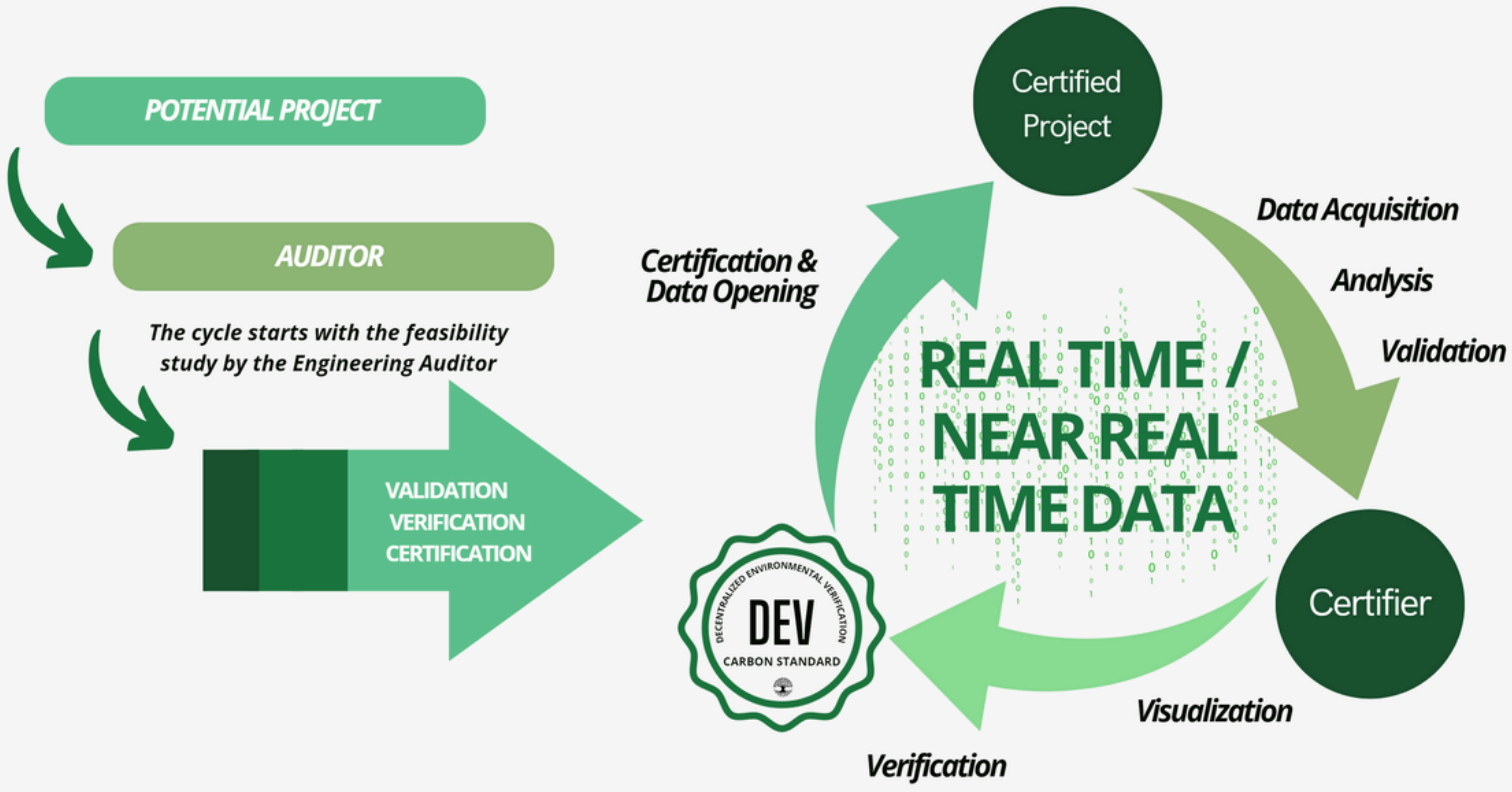
CONTINUOUS DATA CYCLE

Normal Measurement, Reporting and Verification (MRV) practices across carbon markets have an extremely low-frequency data feed: they produce yearly impact reports that are text documents with static data that humans have to create and update manually every time (which means that a person has to read, organize, interpret, analyze, write, and edit information, which equals the possibility of reporting bias, error or worse).

Under the DEV Carbon Standard there are four accepted categories of data feed frequency:

1. Real Time Data. The preferred type when there are KPIs that can be tracked with more robust sensor systems.
2. Near Real Time Data. The second-best option when RTD is not applicable or not viable.
3. High-frequency data feed. The third option, including KPIs that can be tracked with more basic sensor systems.
4. Monthly to yearly reporting. Used only for KPIs that don't require a higher-frequency data update. For example, satellite and drone images would usually be in this category.

This means that in addition to normal MRV and project audit requirements, the DEV Carbon Standard uses a continuous data cycle that is audited under Systems Engineering standards, and of course, open to public scrutiny on the Open Data Platform.



TERMS & CONDITIONS

A. General.

1.- On the principle of open data. Open data in the context of the DEV Carbon Standard means that the data supporting the claims of the carbon offsets must be fully disclosed: data must be shared publicly on a dedicated open data platform. This includes the KPIs, the support data evidencing the stated KPI results, and the data sources of such support data (e.g. details of the specific sensors or satellites used). In other words, the certifier does not reserve the information used to evaluate and certify a project (unless it is personal or IP related information), but instead opens it to public scrutiny on an Open Data Platform.

2.- On the principle of a Systems Engineering approach to data treatment. Open data requires an integral data strategy which includes coherent guidelines to maximize transparency at every point of the certification process. This means that a strategy for efficient and trustworthy data acquisition, data analysis, data visualization, data validation, data verification, and data certification must be in place. This approach is underpinned by the International Council on Systems Engineering (INCOSE) principles. The Auditor will ensure that INCOSEs standards are universally applied to the continuous data cycle for all projects certified under the DEV Carbon Standard.

3.- On the principle of a continuous data cycle. The DEV Carbon Standard framework enables a continuous data cycle which continuously produces real time data (RTD), near-real time data (NRTD), high-frequency data feed and robust data sets throughout the life of the project. The data cycle is made publicly available on the Open Data Platform created by the Certifier of the carbon project.

4.- Protection of the Standard.

The 3 key priorities of the DEV Carbon Standard are: (1) data reliability (via engineering audits of stakeholders for offset creation), (2) data transparency (a full open data policy), and (3) fairness to the stakeholders, particularly landowners, which is achieved via having a cards-open negotiation process between the Project Integrator and the Landowner after the feasibility study has been completed by the Engineering Auditor and both parties know the real carbon capture or avoidance potential of the place and solution, so that they can negotiate on equitable terms their percentages. No secret sauces, no magic formulas, no obscure complex methodologies that end up treating landowners unfairly: just reliable, open, and fair negotiations and cooperation processes that will originate transparent and reliable carbon offsets.

5.- On the Engineering Auditor. The Stewards of the Standard appoint independent Engineering Auditors. To allow for further impartiality, The Stewards of the Standard do not control the employment contract for the Engineering Auditor (for the projects), but remain the only entities which may appoint or change the approved Engineering Auditors.

6.- On the Engineering Auditor's approval to become a Project Integrator, Landowner, Carbon Solution Implementer, or a Seller, under the DEV Carbon Standard. The Engineering Auditor is the sole entity that can approve other key stakeholders for offset creation. The Engineering Auditor audits the data systems of the key actors under the INCOSE (Systems Engineering) and IEEE (Electric & Electronic Engineering) standards and best practices. The Auditor may audit any stakeholder of the carbon offset creation process at any time, including the Certifiers. Should any data system (from the Project Integrators, the Solution Implementers, the Certifiers or the Data Providers) fail for any reason, and data flow to a Certifier's Open Data Platform stops, the Engineering Auditor will evaluate the failing data system and issue a warning to the system's owner and the relevant Certifier: this protocol guarantees that the offset Client never receives unsubstantiated offsets or inflated sequestration figures.

Further, if a data system underpinning the proof of carbon capture or avoidance fails to provide the data feed (in terms of accuracy, precision, timeliness, quantity or quality) for any reason, the offset certification becomes invalid until the data system is validated to be fully functional. No offset is sealed without the necessary support data to evidence its claims. All offsets are based on acquired, analyzed, validated, verified, and certified data, rather than on statistical inferences, formulas or mathematical calculations.

7.- Fiscal year accounting. CO2e tons emitted and accounted for during any given fiscal year by Buyers are compensated with CO2e tons sequestered or avoided (offsets) within the same fiscal year (FY 1 Apr - 31 Mar).

B. Rules regarding Project Integrators.

8.- On the project design. The Project Integrators are responsible for designing a project (Carbon Solution), gathering necessary key stakeholders for offset creation, signing the contracts with all those key stakeholders, and ensuring an optimized information and resource flow throughout the project lifecycle. The design of the project must stipulate the condition of open data (excluding personal or IP related data and non-relevant or non-verifiable data superfluous to measurements).

Project design shall focus on clear, measurable statements and objectives, accurate descriptions of the technologies to be used along the stages of the project, and realistic, optimized KPIs free of ambiguous impact statements.

A Project integrator could have, if its capabilities make it viable, several roles within the offset creation, but never that of Certifier nor Auditor. For instance, a Project Integrator may be the Seller of the offsets, or may be a Solution Implementer: in any case, the Integrator will be audited separately for each of its roles within a project, so covering several roles does require robust capabilities and efficiency.

9.- On the Feasibility Study. The feasibility study is the second step of the Offset certification process, and comes right after the project's initial design. The study has a thorough due diligence with both methodological and Engineering tasks that help the Engineering Auditor define four main things: (1) the project's legal, technical, methodological, and data engineering viability, (2) the baseline, (3) the project's carbon sequestration / avoidance potential, and (4) the project's MRV and data requirements. The deliverable of the feasibility study is a certificate stating if the project is feasible or not, and a report explaining the result. If the feasibility study has a positive evaluation, the Project Integrator can submit the project to a Certifier. Before having the results of the feasibility study no Certifier can consider a project.

10.- On the Compliance Audit. On top of the due diligence already covered by the Engineering Auditor during the feasibility study, a separate Compliance Auditor must make sure that the carbon project complies with any applicable local regulation, with the DEV Carbon Standard, with the DEV Carbon Methodology, and with the DEV Carbon Standard Scientific, Technical and Engineering Framework. The timeframe for this audit is: during the feasibility study or during the first 6 months of the implementation of the project.

11.- On the two types of special audits. There are two additional audits that can be assigned by the Certifier at any time (but no more than once every 12 months) to review a project in detail: (1) the Special Financial, Legal, and Fiscal Audit, and (2) the Special Monitoring, Reporting, and Verification Audit.

12.- On offset types recognized by the DEV Carbon Standard. Project Integrators must choose one of the recognized offset types for each project. If a project does give place to two different offset types simultaneously, the Integrator must consult with the Certifier and the Engineering Auditor for the correct KPI definition in order to be able to measure each offset output accurately and avoid double-counting of CO2e tonnage.

The DEV Carbon Standard currently recognizes seven types of offsets. One which only takes into account CO2, while the other six have measurable positive impacts on other social and environmental areas in addition to CO2e offset. The supplementary impact areas include: food security, biodiversity, waste reduction, freshwater conservation, and sustainable supply & logistic chains.

Any supplementary impact must to be measurable, auditable and proven separately (under the open data principle). Any supplementary impact stated has its own KPIs, support data, and data sources, all of which are audited in the same way as for carbon impact. A project claiming positive social and environmental effects in addition to carbon capture (sequestration) or avoidance, must provide evidence by way of open data. Certification will be revoked from any project not reporting accurate data for carbon sequestration / avoidance or stated social impacts. The DEV Carbon Standard has a zero tolerance policy on misrepresentation of data.

Recognized offset types include:

Offset type ID: OT-01. Land ecosystems Carbon Offsets with a supplementary positive impact on food security and biodiversity. Source: restoration, regeneration, and protection of land ecosystems. Includes measuring and enhancing the nutrients generated by the ecosystem in benefit of the surrounding area and communities. May include integral regenerative agroforestry solutions.

Offset type ID: OT-02. Regenerative Agriculture Carbon offsets with a supplementary positive impact on food security. Source: regenerative agriculture projects.

Offset type ID: OT-03. Carbon offsets from proven avoidance. There are two possible subtypes:

OT-03.1. Avoidance offsets from clean energy projects which have compensated their own carbon footprint. An important note is that up to now many clean energy projects around the world sell offsets without fully compensating their own footprint first, at least not in a way the public can verify. The DEV Carbon Standard requires an audit of the project's carbon accounting and a full open data carbon inset (internal compensation of the carbon footprint, in the form of CO2e tons subtracted from the project's yearly carbon offset output) before the project can sell offsets. This means that no clean energy power plant can sell offsets unless its footprint CO2e tons have been subtracted from the project's yearly CO2e tons avoided. These are avoidance offsets, but with the provision of full carbon accounting & inset, plus the open data policy, they become reliable and verifiable.

OT-03.2. Avoidance offsets from energy efficiency technologies. Innovations that prove emission avoidance via energy efficiency with open data. As with clean energy projects, the project/product carbon footprint must be measured and inset before certifying offsets.

Offset type ID: OT-04. Offsets from direct capture projects & technologies. As for offset ID OT-03 (clean energy projects), the internal footprint must be covered via inset before selling carbon offsets.

Offset type ID: OT-05. Carbon offsets from industrial or agro-industrial innovations and technologies which have a supplementary impact on five areas: food security, biodiversity, waste reduction, freshwater conservation, and sustainable supply & logistic chains. This offset type requires a vast amount of real time data (RTD) and near real time data (NRTD) to prove the positive impact on several areas simultaneously. This offset type is hard to achieve and prove, but has the potential to inspire bold industrial innovations and new clean technologies.

Offset type ID: OT-06. Blue Carbon. Source: coastal, marine, and ocean protection and restoration projects. In the case of Blue Carbon offsets, usually the role of the Landowner as beneficiary of offset payment is substituted by the coastal communities or specific scientific missions with the approval of the authorities with jurisdiction over the coastal, marine or ocean area where the project is developed.

Offset type ID: OT-07. Soil regeneration & carbon capture offsets. Source: soil regeneration practices including regenerative farming and ranching solutions. Projects must account for the carbon footprint of the entire project, including the animals, and inset that footprint before selling offsets.

13.- On the definition of project stages. The development of carbon solutions may take longer in some countries than in others. Some projects pose technology and strategy adaptation challenges, for example in face of changing social, environmental or economic conditions in the area where the solution is implemented. It is important for Project Integrators to structure a timeframe for each project, divided into clear stages that allow for optimal deployment. Gradual growing impacts are encouraged over full day one deployments, to encourage an environment of learning and improvement.

Division into three stages is appropriate for most projects, each with a growing deployment of solutions or technologies implemented to boost carbon capture or avoidance, and growing data sources to match the increasing activity:

(1) inaugural stage (which may include an inset period to compensate for the internal carbon footprint, or a time to test different approaches or technologies on the ground under the specific project conditions: depending on the Auditor's and the Certifier's verdict for each case, this initial stage may or may not produce offsets);
(2) project maturing stage (typically producing already a number of yearly offsets, but not yet the maximum target amount); and
(3) full carbon solution and data system deployment. Stages are designed depending on the nature of the project.

14.- On the principle of additionality with proof-of-value. Open data offsets certified under the DEV Standard must comply with the principle of additionality, but must also include a proof-of-value dimension. This stipulation is important to support efforts of local authorities to monitor large areas of endangered and protected ecosystems.

The Global South is home to thousands of ecosystems protected on paper, which in reality are endangered since they are used for a myriad of illegal activities. Every single day illegal logging, illegal mining, drug production, human trafficking, illegal hunting, and illegal fishing occur in national and local natural reserves which enjoy formal protection status. In many cases the local authorities lack the resources for adequate monitoring of large areas. In other cases these illegal activities take place in private or communal land, including indigenous land, where the local populations also lack the appropriate resources to protect their ecosystems (even if their land is part of conservation programs on paper).

Therefore, if a Project Integrator can prove with open data that the Project is helping an ecosystem recover its health (as it was protected on paper but not in reality), the case will be analyzed by the Certifier and the Engineering Auditor. If the metrics and data quality are deemed adequate and valid by the Certifier and the Engineering Auditor, then offsets may be created.

These cases also require the approval & support from the relevant local or national authorities (or the legal owners of the land under formal protection status. The local or national authority will benefit from the increase in monitoring and restoration of the affected area. The Project Integrator will work in close collaboration with the authorities. The Certifier and the Engineering Auditor will monitor project information flows, and will terminate the project should there be any manipulation or misrepresentation of data - per the DEV Carbon Standard zero tolerance policy. In this case, the Project Integrator will be banned from participating in future DEV Carbon Standard projects.

15.- On the principle of permanence with proof of value. A prevalent misconception arises regarding the term "permanent" in the context of carbon offsets: GHG emitted to the atmosphere can stay there for thousands of years, while a prevailing convention suggests that CO2e must only be sequestered for as little as 30 years in certain instances, to qualify as "permanent". And yet, guaranteeing that a forest will not burn or be damaged under any natural disaster or social unrest event in the next decades can be quite complex in the Global South, where many more integral sustainability solutions are desperately needed. From a scientific standpoint, anything less than an absolute assurance against reversals indefinitely into the future does not align with the true meaning of "permanent", and yet a vague written declaration by a landowner currently passes most due diligence processes.

The DEV Carbon Standard is all about measuring reality and sharing the resulting data in total honesty: the Project Integrators are required to commit to objectives and strategies that contribute to the permanence of their carbon solutions, within the limits of reality and common sense, and with open data to acknowledge any risk factors that threaten or may threaten those commitments in the future.

16.- On the principle of carbon leakage avoidance with proof of value. Closing a coal mine or relocating a factory does not inherently lead to a reduction in CO2 emissions if the displaced production simply shifts to other coal mines or factories elsewhere. This phenomenon, known as leakage, occurs when actions taken in one location trigger counteractive responses elsewhere, reversing the intended carbon reduction benefits. Similar to additionality, and permanence, leakage poses challenges in empirical measurement when assessing carbon offsets and often requires settling for a mere mention of the existence of a plan to avoid it, instead of demanding offset projects to disclose more data to make the tracking of these difficult variables easier every year.

Leakage can manifest at both local and global scales. Local leakage occurs when, for example, protecting 100 hectares of forest from deforestation merely leads to deforestation occurring in the adjacent 100 hectares. On a global scale, solutions may inadvertently displace carbon emissions elsewhere. As the Cambridge Centre for Carbon Credits highlights on its website and reports on the matter: “at the moment we don’t have a fully defined solution to estimate global leakage”.

The absence of comprehensive sustainability and carbon open data complicates efforts to effectively address and study leakage cases. Increasing the availability of open data can facilitate the identification of leakage patterns and discourage its occurrence. In the absence of robust data, written declarations are currently accepted as sufficient proof that a carbon project avoids leakage, which is exactly as it happens with promising offset permanence for 100 years in a forest on a letter.

The DEV Carbon Standard approach to leakage is: measure more and better than you are required to, and open all the data for public scrutiny. In the case of local leakage, context satellite data obtained during the feasibility study helps the Engineering Auditor understand the area surrounding each carbon project from the very beginning, and then constant monitoring during the rest of the project helps track the occurrence and evolution of any local leakage processes. In the case of global leakage, the more data that is shared, the clearer the leakage patterns will become, and the clearer the pathways to de-incentivize it will become

17.- On the baseline. The baseline is calculated by the Engineering Auditor during the feasibility study.

18.- On MRV. Within the DEV Carbon Standard, Measurement, Reporting, and Verification (MRV), are complemented by four additional key aspects: (1) open validation (where anyone with an internet connection may review the relevance, accuracy and quality of the metrics), (2) open verification (anyone may review and share the data supporting the claims of an offset), (3) open data (via a platform where the data of all DEV-approved offsets is made available to the public permanently), and (4) the existence of four different types of third-party auditors, instead of just one.

19.- On how double counting is not possible under the DEV Carbon Standard. Besides additionality, permanence and non-leakage, there is another aspect of offset certification that the lack of data transparency has made hard to track, let alone solve: double counting. The current consensus is that two entities should not be able to claim the sequestration of the same CO2e metric ton. Yet, double counting happens all the time because of the lack of open data: if all offset projects had to disclose all the data backing up every offset, then it would be easy to track the independent geo-referenced data streams behind each project, as well as the real-time status of the project, the real-time offset ownership data, and the cryptographic elements of every offset certificate that would enable a global database of CO2e metric tons "fingerprints". In other words: if all offsets were open data, double counting would quickly become an impossibility.

The retirement of an offset in a carbon registry (the change in its status, from "active" to "retired") is currently done manually. Without universally recognizable and traceable digital "fingerprints", offset retirement is useless in terms of guaranteeing the avoidance of double counting. Why is it so? Because retiring an offset from a carbon registry without knowing exactly what sensor data is linked to that offset in the first place (exactly what CO2e metric ton does that offset represent) is like selling a house via a deed that is not linked it to the house, or that may be linked to a house in that neighborhood, but no-one knows exactly to which one.

The DEV approach to solving this issue is: taking human bias and error out of the offset certification equation by replacing statistical inferences and manual yearly report-writing with engineering, automation solutions, and also by making it mandatory for projects to automatically disclose all the sensor data behind each and every offset certified.

The technical explanation is: DEV enabled a self-updating, geo-referenced, time-stamping, multi-layered cryptographic certification system that seals offset certificates and permanently binds them to data points and data sets streaming on several independent tracks of automated, permanently audited data feeds.

Does this mean using Blockchain for offset sealing? Yes, but that is just one of over 30 dimensions of the DEV Systems engineering solution. Just using digital cryptography such as Blockchain to help users track changes in offset ownership (who owns the offset when) and the eventual retirement of an offset from a registry is extremely easy (it is equivalent to barcodes in a supermarket): the real challenge is proving that the offset itself is built on valid data sets audited under INCOSE & IEEE parameters and streaming from sensors that were tested on certified laboratories, and then binding together the offset with its time-stamped, geo-referenced support data forever, ready for permanent scrutiny over the whole data acquisition, analysis & visualization chain, not just the final envelope, the Blockchain.

20.- On the Project Integrator's relation with the Landowners. The Project Integrator is the point of contact for Landowners (or owners of clean energy projects, or the authorities and communities for Blue Carbon projects). The Integrator informs the private Landowners of the Feasibility Study fees and introduces the assigned Engineering Auditor.

For communal or indigenous land cases, the Integrator will usually have a project sponsor (a company that will get offsets from the project) pay for the feasibility study fees. The feasibility study will advise on: project viability and compliance, the baseline, and estimated annual carbon capture/ sequestration/ avoidance capacity from the project. Based on this information, parties will negotiate shares of future offset sale value. This negotiation phase guarantees fairness (the Landowner receiving the best possible payment within the project's feasibility limits) and rationality in the resource allocation (according to the cost structure) so that the project can be successful and its positive impact can be lasting, measurable, and certifiable. Post negotiation agreements, contracts are signed and the Certifier may start to measure and seal offsets on an annual basis. Then the Seller finds an appropriate Buyer for the resulting offsets (unless the project counted with a sponsor that financed the whole project at the beginning, in which case that company receives the resulting offsets). The Integrator must also tell the Landowner that there will be other audits along the lifecycle of the project.

21.- On the Project Integrator's relation with the Solution Implementers. Project Integrators rely on Solution Implementers to conduct field work to achieve the project's objectives. Solution Implementers deploy the interventions, technologies, and activities which deliver and increase carbon capture over time. Hiring terms for each Solution Integrator will depend on project budget and scope. Collaboration between the Project Integrator and the Solution Implementers starts early at the project design stage, and is confirmed after the feasibility study has provided the parties with financial specifics.

22.- On the Project Integrator's relation with the Sellers. The Project Integrator may promote and advertise the offsets of its projects directly or via third party Sellers. The Integrator must exercise caution when choosing and training the Sellers, since each requires approval from the Engineering Auditor, and is subject to compliance audits as well. If the Seller were to make a false claim about the DEV Carbon Standard, the auditors may suspend or cancel the Seller's license.

23.- On the Project Integrator's relation with the Clients. The Project Integrator is usually the main contact point for the client. Each Project Integrator must have access to the open Data Platform of at least one Certifier, so it can upload, update and sell its projects within the platform. Each project that is uploaded must already count with the approval of the Engineering Auditor and the Certifier, and must count with a project ID. The Project Integrator guides the client through the purchasing process of the carbon offsets on the Certifier's platform, according to the Certifier's guidelines for the use of the platform. Afterwards, the platform automatically distributes the payments to all parties according to the income distribution agreement signed previous to the final offset purchase.

C. Rules regarding Certifiers and the Data Providers.

24.- Data source requirements. The design of devices (e.g. ground sensors) and networks used to collect and distribute the data are evaluated by the Engineering Auditor. The Engineering Auditor will evaluate according to the relevant IEEE, ISO, and INCOSE guidelines. Data Providers must ensure use of approved devices only, other devices will require additional audit processes, including of databases and networks - at the expense of the Data Provider. Should inconsistencies and sensor tampering attempts be uncovered during additional audits, the Data Provider's contract will be terminated, and they will be banned from participation in any Project under the DEV Carbon Standard.

25.- Data Feed. When relevant to the Project's KPIs, real time data (RTD) or near real time data (NRTD) must be streamed into the Open Data Platform. Where RTD or NRTD is not deemed necessary by the Certifier or Engineering Auditor, high-frequency data feeds are preferred over lower frequency data feeds. The Engineering Auditor will specify the data feed frequency and data system requirements for each case, and ensure that the Certifier, the Project Integrator, and the Data Providers comply with such requirements.

26.- Open Data Platform. The support data (evidencing the certified offsets) must be disclose by each Certifier on a dedicated Open Data Platform. Data collected from the carbon solutions must be "open" both in technical and non-technical formats to increase accessibility. Anyone with an internet connection may inspect and interact with the data and share it via social media for maximum exposure and transparency.

27.– Traceability, immutability & visibility of the offset certificates. Each Certifier must guarantee that the certificates are reliable and un-alterable, and must always be linked to the original data source - where the data may be viewed by anyone (via the Certifier's Open Data Platform).

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THE DEV CARBON STANDARD

2024 EDITION