Flexidao

GC Scheme Protocol

Configuration #3

2025

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Introduction

Flexidao Holding B.V. is a private company based in Amsterdam, The Netherlands. Flexidao provides companies with data and software to manage effectively large portfolios of electricity contracts, energy certificates and self-production. We act as intermediaries between suppliers, grid operators, consumers and registries facilitating data exchanges, interoperability and portfolio optimizations. Flexidao specializes in innovative software solutions that connect electricity procurement with its real carbon impact. By collecting and analyzing detailed data related to both time and location, Flexidao provides a unique service to enhance transparency and efficiency in the energy sector.

Flexidao is committed to transparency and innovation. The purpose of this document is to share Flexidao's internal technical architecture concerning the issuance, transfer, and cancellation of Granular Certificates (hereafter addressed as GCs). This information will be disclosed to allow EnergyTag to audit and recognize Flexidao as an official issuer of GCs within the specific framework of Configuration #3. This framework is detailed in the "Granular Certificate Scheme Standard v2" published in 2024 by EnergyTag

Independence and Governance

Flexidao Holding B.V. maintains complete independence in its operations, ensuring the integrity and impartiality of its Granular Certificate (GC) issuance services. While some of our shareholders may be large energy buyers, these shareholders hold only minority stakes in the company and do not occupy any seats on our Board of Directors. Flexidao Holding B.V. is incorporated under Dutch law as a Besloten Vennootschap (B.V.), where the responsibilities and powers of shareholders and directors are clearly defined by the Dutch Civil Code (specifically Book 2 of the Burgerlijk Wetboek). Under this legal framework:

- **Board Autonomy:** The day-to-day management and strategic decision-making authority rest with the company's management board. Directors are charged with promoting the best interests of the company, its business, and its stakeholders as a whole (Article 2:239 of the Dutch Civil Code). Shareholders, especially those holding a minority interest, do not have any legal right to issue binding operational instructions to the board.
- **Minority Shareholders' Limited Influence:** While shareholders may exercise influence through general meetings—such as the approval of annual accounts, appointment or dismissal of directors, and certain key structural decisions—minority shareholders do not possess a controlling interest.
- **Fiduciary Duties of Directors:** Directors are required to act independently and in the interest of the company as a whole, not at the behest of individual shareholders. This fiduciary duty ensures that even if a shareholder has commercial interests outside the company, those interests cannot override the board's obligation to maintain impartial and principled governance.

By virtue of these legal provisions under Dutch law, Flexidao stakeholders have no direct or indirect mechanism to influence the operational or strategic decisions related to Granular Certificate issuance.

By upholding this transparent and independent framework, Flexidao aligns fully with the EnergyTag standard. Our measures ensure that all stakeholders can trust the neutrality and objectivity of our GC issuance process, thereby preserving the credibility and integrity of the energy tracking ecosystem.

1. Roles and Governance

In the administration of a Granular Certificate (GC) Scheme, various roles are essential to ensure the proper functioning and integrity of the system. These roles may be vested in a single party or distributed among several entities, each with distinct responsibilities. The interaction between these roles is critical, with certain interactions being mandatory to maintain trust and reliability within the Scheme.

1.1 GC Issuer – Flexidao

The GC Issuer plays a pivotal role in the administration of GCs within a given domain for an Energy Carrier. This role is primarily responsible for issuing and managing GCs, ensuring that there is no double counting of the attributes represented by these certificates throughout their lifetime. The GC Issuer must adhere to specific criteria set out by the GC Issuer and demonstrate compliance with the EnergyTag GC Issuer Accreditation Process. This ensures that the issuer operates independently of the production, trade, and supply of GCs, preventing any conflicts of interest.

In our context, Flexidao will serve as the GC Issuer. Flexidao will administer and register the GCs throughout their lifecycle, maintaining a transparent and trustworthy system. The GC Issuer is also responsible for issuing GCs based on inputs from the Production Registrar and ensuring the criteria for becoming an registry user are robust to prevent fraudulent use of the GC Scheme. Flexidao does not own or hold a beneficial entitlement to any GC except to prove its own consumption, for testing purposes or as a means of recovery from public support mechanisms. Furthermore, the Flexidao ensures that the rules and provisions of the GC Scheme are publicly available in English, using formats proposed by EnergyTag for different configurations.

1.2 GC Registrar – Flexidao

The GC Registrar is tasked with assessing applications to register Production Devices for issuing the relevant Certificates. This role involves meticulous record-keeping and reporting to the GC Issuer, especially when different parties are involved. The GC Registrar's responsibilities include determining the quantity of Certificates to be issued and informing the GC Issuer accordingly.

Flexidao will also assume the role of the GC Registrar, ensuring that all applications and records are meticulously maintained and reported in all regions that Flexidao operates in as a GC issuer, see Appendix 1. This dual role by Flexidao facilitates streamlined operations and reduces the complexity of interactions between different entities.

1.3 GC Registry Operator – Flexidao

The GC Registry Operator is another critical role that will be undertaken by Flexidao. This role involves maintaining a comprehensive registry of all GCs, including the characteristics of the Production Devices and the accounts and certificates held within them. The operator ensures that the data is consistent with the underlying **Energy Attribute Certificate (EAC)** Registry and complies with the EnergyTag Standard.

By centralizing the roles of GC Issuer, GC Registrar, and GC Registry Operator within Flexidao, we ensure a seamless integration and efficient administration of the GC Scheme. This centralization also helps in maintaining consistent records and ensuring compliance with all relevant standards and protocols.

1.4 GC registry user – Any registered party

Flexidao allows users to register as GC registry users, enabling them to participate actively in the GC Scheme. To get an account in the registry accepted, the registry user needs to sign a contract with Flexidao. This contract includes a crucial agreement to prevent double issuances. The registry user must agree to apply for GCs with only one GC issuer for every EAC production period that is canceled on their behalf. Also, the registry user needs to declare no double allocation of EACs or GCs.

The registration process includes a Know Your Customer (KYC) procedure conducted by the GC Issuer to ensure the legitimacy of the registry user. Once approved, the issuer creates user accounts, granting them access to the GC registry.

The GC registry user can perform several actions within the registry, including:

- **Create a GC Request:** registry users can submit requests for GCs. These requests must meet the requirements outlined in the subsequent chapter, ensuring that all submissions are thorough and compliant with the established criteria.
- **View Canceled Balances of GCs:** Upon approval of a GC request by the issuer, registry users can view the canceled balances of GCs in their account. This transparency allows users to monitor their certificate transactions and ensure the integrity of their account balances.

By incorporating these functionalities, Flexidao ensures that GC registry users have the tools and information necessary to manage their certificates effectively, maintaining trust and efficiency within the GC Scheme.

1.5 Measurement Body (e.g. DSO/TSO/Meter companies)

The Measurement Body is responsible for the accuracy and reporting of measurement data related to the energy produced or consumed at various points. This role is crucial for ensuring the integrity of the data used in the GC Scheme. The Measurement Body must either be independent of production, trade, and supply or be subject to regular independent audits to confirm the accuracy of the reported measurement data.

In our GC Scheme, the Measurement Body will be the same entity used by the EAC Registry, which could be a Distribution System Operator (DSO), Transmission System Operator (TSO), a specialized measurement company, or another qualified organization. This alignment ensures consistency and reliability in the measurement data used across both the EAC and GC Schemes.

1.6 EAC Issuer – Any existing EAC issuer

The EAC issuer is an essential role of existing EAC systems, designed to track and verify the production and consumption of renewable energy. The EAC issuer prevents double counting of environmental attributes by ensuring that each unit of energy is uniquely recorded and attributed. , EAC systems issue certificates on a monthly basis, providing reliable registration of renewable energy attribute transactions.

1.7 EAC registry operator (Any existing EAC registry operator)

The EAC registry operator is responsible for maintaining and managing the infrastructure that records and tracks renewable energy certificates. The operator ensures that all issued, transferred, and cancelled certificates are accurately documented within a secure and transparent system. The EAC registry operator can be the same entity as the EAC issuer, but can also be another entity. See Appendix 1 for an overview of all existing registries.

In Configuration #3, the EAC registry operator's system generates cancellation reports for cancelled EACs. These reports serve as the input needed for issuing Granular Certificates (GCs).

1.8 Summary of roles and responsibilities

The administration of a GC Scheme involves multiple roles, each with specific responsibilities critical to the system's integrity and reliability. Flexidao's involvement as the GC Issuer, GC Registrar, and GC Registry Operator simplifies the operational complexity and ensures a robust administration framework. By adhering to the standards and protocols set forth by EnergyTag, we ensure that the GC Scheme operates transparently and efficiently, providing trust and confidence to all stakeholders involved.

Role	Fulfilled by	Configuration #3 responsibilities
GC issuer	Flexidao	Administration, registration, compliance with EnergyTag standard, double counting prevention
GC registrar	Flexidao	Responsible for the validation and the accuracy of registered data
GC registry operator	Flexidao	Registry maintenance, data consistency
EAC registry operator	Any existing registry operator, see Appendix 1	Providing EAC cancellation statements
Measurement Body	Any identified production data provider, see Appendix 2	Providing granular production data that is of settlement grade.
GC Registry user	Any registered party	Request GCs, monitor transactions

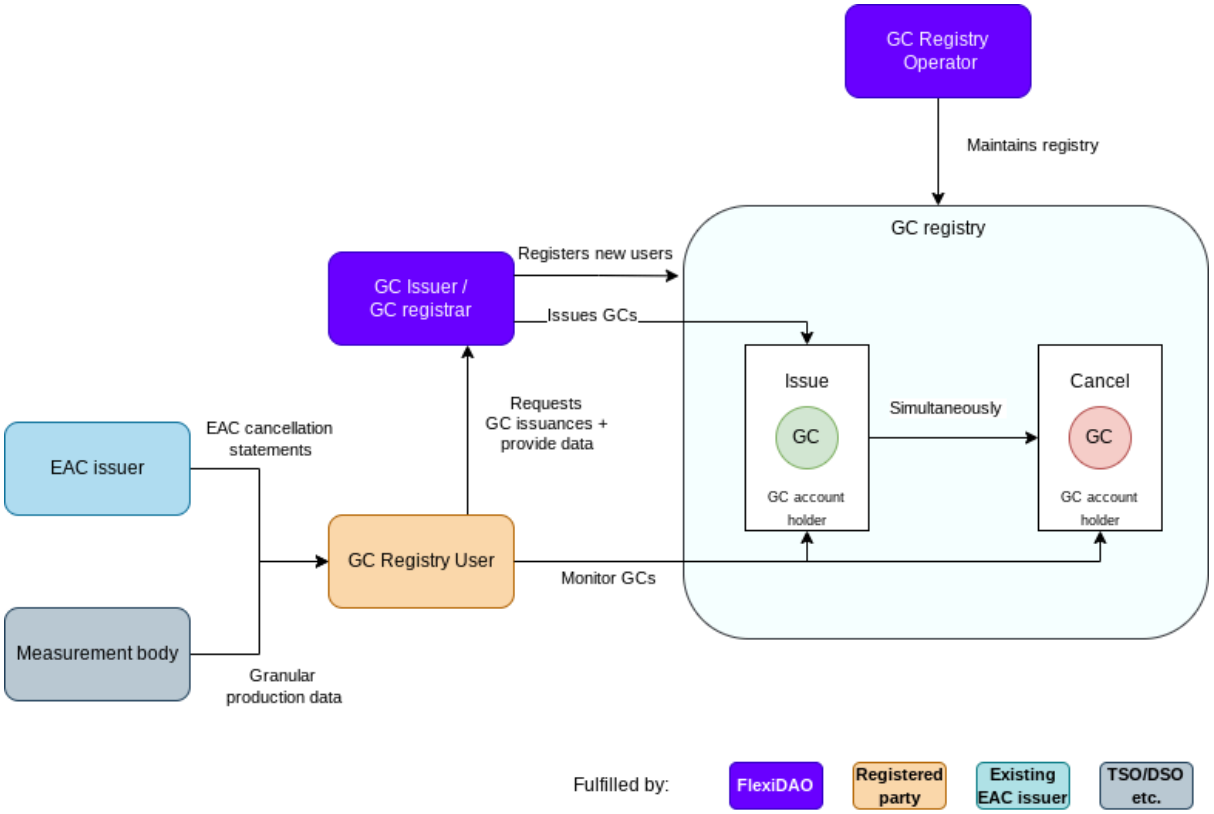

Figure 1: Summary of roles and responsibilities

2. GC Scheme configuration

This chapter provides a comprehensive overview of our process for creating, validating, and issuing GCs. The process supports compliance with the EnergyTag Granular Certificate Scheme Standard Configuration #3: GCs based on cancelled EACs, allocated to the same beneficiary.

2.1 Configuration #3 scheme and solution set-up

2.1.1 Configuration #3

GCs (GCs) in Configuration #3 offer a specialized approach to ensure the accurate and transparent tracking of renewable energy production and consumption. **This configuration is used when neither Configuration #1 nor Configuration #2 is supported by the EAC Issuing Body within a specific domain.** Configuration #3 facilitates (sub)hourly matching of production attributes to consumption, effectively preventing double counting and double issuing risks of the represented energy.

This configuration enables reliable GCs where the EAC issuing body is not ready to take responsibility over them. With unique GC-IDs, it allows for verifiable and traceable mechanism that prevents double claims while keeping official EAC system statistics intact. The GCs issued by Flexidao in Configuration #3 will be non-tradeable GCs and do not participate in setting a market value for specific production times.

2.1.2 Solution set-up

Flexidao's solution for managing GCs is designed around two core services: the GC registry service and the issuer service. These services work in tandem to ensure a secure, and reliable process for creating, validating, and utilizing GCs.

1. The GC Registry Service The GC registry service is the backbone of the solution, responsible for storing all important attributes and information of GCs throughout their lifecycle. This registry acts as a centralized repository, accessible to users of the registry, where detailed data about each GC is maintained. This includes attributes such as the certification details, beneficiary information, and production details, see Chapter 4 . By providing access to this comprehensive data, the GC registry service ensures transparency and traceability, which are essential for maintaining the integrity of renewable energy claims.

2. The Issuer Service The issuer service, operated solely by Flexidao, is tasked with the crucial role of issuing GCs on the registry. This service is responsible for storing and validating all the underlying data required for GC issuance, such as production data and Energy Attribute Certificate (EAC) data. Unlike the GC registry service, the issuer service is not accessible to general users; it is restricted to the issuer (Flexidao) and serves as an admin tool for managing the GC registry. The issuer service is the only service authorized to trigger GC issuances on the registry, ensuring strict control and oversight to prevent double counting and other discrepancies.

In the following sub-sections, a comprehensive explanation of how this process works in Flexidao's GC registry is provided.

2.2 User creation

Flexidao's GC registry supports two types of users: the issuer and general users. The creation and management of these users are handled through a well-defined process to ensure security and compliance.

1. Issuer Flexidao is the sole issuer on the GC registry. As the issuer, Flexidao has the critical responsibility of ensuring that there is no double counting of GCs. The issuer validates all GC issuance requests based on EnergyTag requirements and decides whether to approve or reject each request. This validation process is fundamental to maintaining the accuracy and reliability of the GC registry.

2. User General users can access the GC registry following a Know Your Customer (KYC) process. Here's how user creation works:

- **Terms & Condition Agreement:** To get an account in the registry accepted, the registry user needs to sign the terms & conditions with Flexidao. This includes a crucial agreement to prevent double issuances. The registry user must agree to apply for GCs with only one GC issuer for every EAC production period that is canceled on their behalf. Also, the registry user must agree that when issuing GCs, the EACs will not be used otherwise for claiming or marketing. Furthermore, the registry user is responsible for specifying the consumption period and consumption location when required. This information is necessary for the issuer to validate that it aligns with the details stated on the EAC statement, ensuring consistency and accuracy in the matching process.

1. Environmental Attribute Declaration: The registry user hereby declares and warrants that the environmental attributes associated with the energy for which they are applying for Granular Certificates (GCs) are not, and will not be, allocated to any other certificate application or used for any other claim of environmental benefits associated with the consumption of this energy. This includes, but is not limited to, any claim of greenhouse gas reductions, renewable energy usage, or any other environmental impact associated with the energy produced.

2. Exclusive Application for Granular Certificates (GCs): The registry user agrees that for each Energy Attribute Certificate (EAC) production period, they will apply for GCs with only one GC Issuer, ensuring no double issuance occurs. The registry user further agrees that once the GCs are issued, the associated EACs will not be claimed or marketed for any other purpose, including any other environmental claims or certificate issuance or consumption in any other location or time interval.

3. Responsibility for Specifying Consumption Data: The registry user is responsible for providing and specifying the consumption period and consumption location. This information is necessary to

allow the GC issuer to validate whether it aligns with the details provided in the EAC statement. Failure to provide accurate consumption period and consumption location may result in the non-issuance of certificates.

Figure 3: Sample clause between Flexidao and registry user

- **KYC Process:** Prospective users must undergo a KYC process to verify their identity and eligibility to participate in the GC registry. This step is crucial for maintaining the security and integrity of the registry.
- **Issuer Approval:** After the KYC process and contract agreement, the issuer (Flexidao) reviews the application. If the issuer approves the application, a new user account is created on the registry.
- **User Access:** Once approved, the user gains access to their account on the GC registry. This account allows them to interact with the registry, view detailed GC information, and participate in the renewable energy tracking process.

By managing user creation through a controlled process, Flexidao ensures that only verified and approved participants can access the GC registry. This setup supports the secure and efficient operation of the GC solution, fostering trust and compliance among all stakeholders.

2.3 GC issuance request

This section outlines the steps and requirements for submitting a GC issuance request, detailing the information needed and the validation process undertaken by the GC issuer.

2.3.1 Components of a GC Issuance Request

To initiate a GC issuance request, a requester must provide specific information and documentation. A GC issuance request must include the following components:

1. **Requested GC Quantity** The specific volume of GCs that the user wishes to issue in Wh.
2. **Underlying Proof Documents** To support the requested GC quantity, two essential documents are required:
    a. Cancelled EAC transactions - Each row of an EAC cancellation transaction represents a batch of consecutive certificates IDs that have a specific period (start and end). See details in 3.3.2
    b. Production Measurement Data - see details in 3.3.2
3. **Additional Data**
    a. It is required to provide the mapping device ID of the EAC and measurement data to further support the request.
    b. Production device capacity

c. Production device technology type (if not stated in the EAC)
d. Production device commissioning date (if not stated in the EAC)
e. [Optional] Any other additional information to support the request like:
    i. Production device Zip code, street, city, and latitude and longitude, operational date
    ii. Indicate if issued following the release of energy from a storage system (yes/no).
    iii. Indicate if issued following energy carrier conversion (yes/no).

2.3.2 Detailed Requirements for Underlying Proof Documents

Cancelled EAC transactions

- **Source Proof Document**: The EAC transactions must be a proof document from an existing EAC registry and it must be clear from which registry the EAC is from.
- **Transaction Type**: The document must show that the transaction type is cancellation.
- **Face Value/Quantity**: The document must state the face value or quantity of the certificate.
- **Source:** The document must specify the energy source represented in the EAC.
- **Beneficiary**: The document must state the beneficiary of the EAC.
- **Production Device**: The document must include the production device name and ID
- **Production Period**: The document must specify the production period of the energy expressed in UTC in RFC 3339 format .
- **Production country:** The document must specify the production country to understand the location of the production.
- **Certificate IDs:** Normally comes with the following format: From Certificate ID - To Certificate ID
- **Commissioning date:** the document may specify the production device commissioning date - if not available, the GC issuance requester must provide the production device commissioning date.

Production measurement data

- **Source:** Name of the source of where the data comes from
- **Meter provider code**: The document must provide the code used by the provider for identifying an unique metering point
- **Production Period**: The document must specify the production period of the energy expressed in UTC in RFC 3339 format.
- **Validity Level**: It must be specified what the validity level is of the data. There are three levels of validity considered:
    - **Settlement Data**: Hourly energy production data from renewable assets, validated by market authorities such as Distribution System Operators (DSOs). This data is used for various market processes, including billing and reconciliation, and is considered highly reliable because it has been verified for accuracy and is used in official market settlements.

- **Preliminary Data:** Initial meter readings before final validation by market actors. This data can be provisional and is not as reliable as settlement data. Preliminary data will **not** be accepted for issuing GCs.
- **Estimated Data:** Production or consumption estimates based on scenarios or assumptions, used when actual measurement data is unavailable. Estimated data will **not** be accepted for issuing GCs.

2.3.3 Sprocessubmission and Validation

Once the requester has compiled the necessary information, including the requested GC quantity, EAC transactions, measurement data, and any additional data, they submit this information to the GC issuer. Upon receiving a GC issuance request, the GC issuer begins a thorough validation process.

The issuer is required to validate the following:

Check	Description	Automated/Manual
EAC transactions Review	Ensure the certificates are valid from a real EAC registry	Manual
	Ensure that the certificates have been appropriately cancelled	Manual
	Ensure that the EAC quantity corresponds to the requested GC quantity.	Automated
Production Data Validation	Examine granular production measurement data to confirm data quality, see Appendix 3	Manual
	Examine granular production measurement data to be settlement-grade, see Appendix 4.	Automated
	Examine that the production measurement data is from an eligible production of the Production Device referred to on the canceled EACs,	Automated

Consistency Check	Verify total energy volume represented by canceled EACs matches the volume of (sub)hourly measured production data. **Formula:** (sum of EACs/sum of granular production data)×production data (h)=GC issued requested (h)	Automated
Energy Volume Check	Ensure the sum of GCs requested does not exceed the amount of energy represented by corresponding canceled EACs.	Automated
Beneficiary Verification	Verify that a beneficiary is identifiable on the EAC cancellation. The identified beneficiary automatically is also the beneficiary for the issued GC. The party that cancels the EAC certificate automatically claims the associated renewable energy consumption benefits. Unless it is explicitly stated that the benefits are designated to another party, the entity listed as the canceling party on the EAC statement is considered the default beneficiary. When no EAC beneficiary is identifiable, no GCs will be issued.	Automated
Consumption period & Consumption location check	Verify that a Consumption period and Location are identified on an EAC cancellation statement. When a user initiates a cancellation, they must specify the beneficiary and location, which are then recorded on the resulting cancellation statement or proof of cancellation. When identified, Flexidao makes sure that the consumption information on the canceled underlying EAC corresponds with the GC issuance. In the case it is not identified, the user is responsible for providing the consumption period & location, as specified in the T&C.	Automated
Unique EAC ID Check	Ensure underlying EACs have unique EAC IDs and have never been used before for GC issuance by Flexidao	Automated

Additional Data Review	Review additional data provided in the request:. a. Production device capacity b. Production device technology type (if not stated in the EAC) c. Production device operational date (if not stated in the EAC) d. [Optional] Any other additional information to support the request like: iv. Production device Zip code, street, city, and latitude and longitude. v. Indicate if issued following the release of energy from a storage system (yes/no). vi. Indicate if issued following energy carrier conversion (yes/no). Flexidao will check where possible directly with the production project if the submitted information is true. If no check is possible, the additional data might be rejected.	Manual

After completing the validation process, the GC issuer decides whether to approve or reject the GC issuance request:

If approved, the GCs are issued and immediately canceled, ensuring that no GCs remain in circulation without corresponding renewable energy production data.

If rejected, no GCs will be issued. The user will receive a notification detailing the rejection, including the reasons for the decision. Upon receiving this response, the user has the option to address the issues highlighted and submit a new request for consideration.

2.4 GC issuance and cancellation

In this section, we will explore the detailed process oGC issuance and cancellation. Once a GC issuance request is approved by the GC issuer, the process is triggered and executed simultaneously. This simultaneous issuance and cancellation ensure that no GCs circulate without corresponding renewable energy production data, thereby preventing the risk of double usage and maintaining the robustness of the system.

2.4.1 Issuance and Cancellation process

The process begins with the approval of a GC issuance request by the GC issuer. The issuer validates the request based on the provided Energy Attribute Certificates (EACs) and granular production data. Once the request is approved, the issuer triggers the issuance and cancellation of GCs. This simultaneous action guarantees that the issued GCs are immediately

canceled, ensuring that users cannot transfer or cancel their certificates independently. The issuer ensures that each issued GC has a unique ID that relates to the corresponding EACs, maintaining traceability and preventing double counting.

The issued and canceled GCs are then made available for the user, where they can be monitored. This allows users to verify the authenticity and status of their GCs, ensuring transparency and trust in the renewable energy tracking process.

2.4.2 Validation check GC issuance

Flexidao as the GC issuer performs multiple checks, see 3.3.3. Among those checks, Flexidao ensures that across the issuance period of the EACs received (i.e. monthly/yearly), the total volume of the EAC is equal to the issued GC.

Different cases arise from this check:

- The volumes of EACs, Production data & GCs match - in which case the validation has been successfully completed without the need of any countermeasure. This automatically triggers the issuance of GCs that represents official Energytag's GCs and are thus officialized in the GC Registry
- The volumes do not match because of slight misalignments (for example because of EAC adjustments for previous months) - in the case that the volumes differ by less than 1MWh per production device (i.e. less than 1 potential issued EACs) the registry will perform the reshaping of GCs to issue the quantity that aligns with the official volume of issued EACs. (More on reshaping 3.4.3 Application Methodology for GC issuance - reshaping)
- The volumes do not match for misalignments bigger than 1MWh per production device - in this case, the registry performs a secondary check to verify whether the EACs have been issued by a registry that considers auxiliary loads. [1] As for the case above, In the case that auxiliary loads are the reason of the misalignment, Flexidao will **not continue** to the issuance of GCs and will request updated metering data from the requester.

By utilizing this approach, the confirmed GCs issued will always be equal in volume to the total EACs issued received while they will be slightly different from the measurement data collected from the PVB.

2.4.3 Application Methodology for GC issuance - reshaping

When issuing GCs with discrepancies between EAC and production data,, there are two primary methodologies to consider: issuing proportionally and issuing by selecting specific volumes per hour. Proportional issuance distributes GCs based on the proportion of total production for each hour, reflecting the actual energy production profile. Volume selection

[1] For GOs this load is subtracted from the total production before issuance on a monthly basis. Applying the same methodology on an hourly basis leads to discrepancies due to specific hours when the plant has zero production and only consumption (it is not possible to issue negative GCs). Auxiliary load always causes a negative discrepancy, meaning that *issued_GCs > issued_GOs*

issuance allocates specific volumes of GCs for each hour based on the buyer's wishes, allowing for precise adjustments and customization.

Each methodology has its advantages and disadvantages, which are summarized in the table below:

Methodology	Advantages	Disadvantages
Proportional Issuance	• Simplicity: Easy to implement, reducing administrative complexity. • Fair Distribution: Reflects true energy production profile, ensuring balanced allocation. • Transparency: Clear method for stakeholders to understand GC allocation.	• Lack of Flexibility: Limited customization for specific needs or preferences. • Fixed Allocation: Inflexible in handling unusual production patterns or special cases.
Volume Selection Issuance	• Flexibility: Allows for precise adjustments based on specific needs or buyer preferences. • Tailored Allocation: Better handles unusual production patterns or special requirements.	• Complexity: More complex and time-consuming, requiring careful selection and validation. • Potential for Bias: May introduce subjective decisions, leading to disputes or perceived unfairness. • Increased Risk of Errors: Detailed selection process can increase the risk of errors, requiring more oversight.

Flexidao follows a **Proportional Issuance methodology** to issue GCs. The methodology allows the beneficiary to claim the same percentage of energy every hour, where the percentage is calculated as purchased EACs divided by total EACs.

To convert monthly EACs to hourly GCs using hourly production data, you can use the following formula. This formula ensures that the total quantity of canceled EACs is accurately distributed across the hours based on the proportions of hourly production data.

Proportional Allocation Formula per hour

$$GCs_h = Total\ canceled\ EAC \bullet \frac{Hourly\ production_h}{\sum_{i=1}^{H} Hourly\ production_h}$$

- GCs_h: The volume of GCs in MWh allocated for hour h.
    - This represents the hourly distribution of the total canceled EACs based on the hourly production data.
- $Total\ canceled\ EAC$: The volume of EACs in MWh from the specific asset.
    - This quantity must be the same as the total quantity of GCs issued.
- $Hourly\ production_h$: The amount of energy produced during hour h.
    - Used to determine the proportion of total production that occurred during hour h

To apply the formula:

1. Sum the hourly production data to get the total monthly production.
2. Calculate the proportion of production for each hour by dividing the hourly production by the total monthly production.
3. Multiply the total canceled EACs by the hourly proportion to get the hourly GCs.

2.4.4 Use-cases for proportional GC issuance

In this section, we provide 4 common use-case scenarios and examples of how Flexidao applies the proportional methodology for GC issuance.

Use case 1: Single Buyer Purchasing 100% of Output

In this straightforward scenario, a single buyer purchases 100% of the energy output. Since the buyer is entitled to the entire output, there is no need for proportional allocation.

Use case 2: Single Buyer Purchasing a Percentage of Output

In this case, a single buyer purchases a specified percentage of the energy output. The GCs are allocated proportionally based on the percentage of EACs purchased.

Use case 3: Multiple Buyers Purchasing 100% of Output

When multiple buyers purchase 100% of the output, the GCs are allocated proportionally among them based on their purchase percentages.

Use case 4: Multiple Buyers Purchasing a Percentage of Output

For multiple buyers purchasing a percentage of the output, the GCs are allocated proportionally based on their purchase percentages.

See Appendix 5 for examples of the use cases.

2.5 GC monitoring and matching

GCs produced by Flexidao include comprehensive information, ensuring transparency and traceability. For a detailed list of all attributes contained in the GCs, see Chapter 4.

Once issued and canceled, GCs are available for monitoring through the user's account. Users can access detailed information about their GCs, including the production attributes and beneficiary details, which can be used for various purposes.

One key application of GCs is for matching purposes. By matching the production attributes of GCs with energy consumption, users can validate their renewable energy usage, ensuring compliance with standards and regulations. Note that the GC registry does not provide the matching functionalities. For more detailed information on matching, refer to the Matching Standard of EnergyTag.

This systematic approach to GC issuance, validation, and monitoring ensures that the renewable energy certificates are not only accurate but also provide a reliable basis for tracking and reporting renewable energy consumption.

3. GC Attributes

The GCs issued under Flexidao's registry system adhere to the highest standards to ensure integrity and reliability. Specifically:

- Immutability: Data recorded on the GC are never removed or modified from issuance to cancellation, ensuring the integrity and permanence of the information.
- No Duplication: GCs are not duplicated or double-counted, preventing any possibility of fraud or overestimation of renewable energy production.
- Replication of EAC Attributes: GCs are replicating the attributes found on any underlying EACs in the same domain, ensuring consistency and accuracy in the representation of renewable energy data.

These principles are foundational to maintaining the trust and transparency required for effective renewable energy tracking and reporting. In the following table, the attributes of GCs are provided:

Attribute	Description	Derived from	Format
Energy Carrier	Must state the energy carrier.	EAC transactions	[Electricity]
Certificate ID Range Start/End	Unique ID received at issuance and maintained over the full certificate lifetime. Format always starts with the EAC registry name, followed by the EAC Certificate ID + 6 -digit number representing the energy quantity down to Wh.	Flexidao	[Registry_EACID_000000]
Production Device Commissioning Date	Date when the production device became operational, expressed in UTC in RFC 3339 format	EAC transactions / supporting documents	[YYYY-MM-DDThh:mm:ss TZD]
Production Period Start	Start time stamp of the production, expressed in UTC in RFC 3339 format	EAC transactions + measurement data	[YYYY-MM-DDThh:mm:ss TZD]
Production period End	End time stamp of the production, expressed in UTC in RFC 3339 format. The difference between Start and End is always 1 hour Checks if, when a Consumption period available on the EAC, if the production period falls within the Consumption period.	EAC transactions + measurement data	[YYYY-MM-DDThh:mm:ss TZD]
GC Issuance Date	UTC date-stamp of issuance, expressed in UTC in RFC 3339 format.	Flexidao	[YYYY-MM-DDThh:mm:ss TZD]
Energy Source	Source of the produced energy.	EAC transactions	[Solar/Wind/etc]
Energy Technology	Technology of the produced energy	EAC transactions or Supporting documents	[Off shore wind]
Production Device Name	Name of the production device.	EAC transactions	[NAME]
Production Device ID	Unique ID of the production device (if available).	EAC transactions	[ID]
Production Device Capacity	Capacity of the production device (if available)	Supporting documents	[MW]

Registry country	Country or region where the GC is issued.	Flexidao	[Spain]
Country of production	Country of the production device.	EAC transactions + supporting documents	[Country]
Location of production	Exact location of the production device GPS etc	Supporting documents	[Longitude/latitude]
Energy Unit	Wh as the base unit.	Flexidao	[in Wh]
Quantity	Face value of the certificate, rounded down to the nearest Wh.	EAC transactions + measurement data	[#]
Beneficiary Name	Organization name that is the same as the EAC beneficiary	EAC transactions	[NAME]
Beneficiary ID	Organization ID that is the same as the EAC beneficiary	EAC transactions	[ID]
Issuer Authority Name	Identity of the GC issuer.	Flexidao	[Flexidao]
Storage Tag	Indicate if issued following the release of energy from a storage system.	Supporting documents	[YES/NO]
Cancellation purpose	State what the purpose is of the cancellation	EAC transactions	[Disclosure purposes]
Conversion Tag	Indicate if issued following energy carrier conversion.	Supporting documents	[YES/NO]
Configuration	State the configuration under which the GC is issued (Config-1, 2, or 3).	Flexidao	Config-3
Underlying EAC registry	Name of the registry of the cancelled EAC	EAC transactions	[Registry]

4. Production metering and data registration

4.1 Registration data – production device

Flexidao's GC registry establishes the following procedure regarding registering production devices - in accordance to the Energytag GC Scheme standard:
If a production device is already registered in an EAC Registry, all production data from the EAC Registry Account are provided to the GC Issuer to ensure consistency. This needs to be provided by the user when creating a GC issuance request, see Chapter 3.3.1 Components of a GC Issuance Request

If a production device is registered for EACs, it needs to have the following information:

a. Production device ID unique to the Domain,
b. The name of the production device,
c. the Registry Account into which the GCs for the units of produced energy will be Issued, or a request to open such an Account
d. Geographical location of Production/Storage Device (including zip code / postcode, street, city and country, and/or latitude & longitude).
e. A reference to an identification of the grid (or other transport means) into which the energy is injected (if grid connected and available), and
f. [If available] Details of any production auxiliaries associated with the Production Device
g. All energy sources which may be converted into an output Energy Carrier of the production device,
h. The technology type used by the production device,
i. The capacity of the production device,
j. The date when the production device became operational
k. The identity of the Measurement Body responsible for collecting and determining the energy produced by the Production Device and providing this to the GC and/or EAC Issuer,
l. [If available] details of any payments of public support which have been made or are due in association with the Production device
m. [If available] A diagram of the Production Device, including details of the location of the entry and exit measurement point(s) for the Production Device and of any Production Auxiliaries connected to the Production Device
n. [If available] the identity of any label scheme under which this Production Device is accredited,
o. Meter ID, including an indication of whether this is gross or net measurement of generation
p. [If available] Meter type (utility, submeter)
q. [If available] Meter serial number, and
r. [If available] the associated utility consumption meter ID and any other behind-the-meter production or storage IDs, for production systems that are behind a utility consumption meter. Data for each associated consumption, production, or storage ID should be reported according to the data requirements in 1.3 Consumption Metering and Registration Data for Matching of the GC Matching Standard.

For applications for GCs where the EAC Registry data omits the data below, applicants seeking to register a Production Device shall grant access to the GC and/or EAC Issuer to the Production Device together with records relating to it which will enable the information provided in connection with that application to be verified.

If these details are not provided, the user requesting GCs in Flexidao's registry is solely responsible for updating and verifying the accuracy of the data.
For energy source and device capacity, Flexidao reserves the right to inspect the data (documentation reviews, third party certifications, grid data checks and if applicable on-site audits). If the information cannot be verified, the device will not be registered.
If a production device is not registered yet for EACs, it will not be eligible for config 3 GC issuance under this protocol.

4.2 Production measurement data collection

Granular production data in Configuration #3 by Flexidao must be **settlement-grade,** it is provided in 2 ways:

1. Automated Integration with Flexidao – See the list below for supported data sources.
2. Client Uploads – If the client has settlement hourly production data from their suppliers, they can upload it directly. Flexidao performs checks to ensure the accuracy and validity of the submitted data - see data checks in Appendix 3

Production data should send to the register the following information per each reporting period (see 3.3.2):

- Meter provider code
- Production Period
- Validity Level

Data sources may vary from TSO/DSOs datahubs, Energy suppliers databases, OEM and EMS systems, see Appendix 2. The GC issuer will always prioritize sources as follows to minimize any potential discrepancies between the data collected by the EAC registry and the GC registry:

1. Directly from the DSO
2. From the supplier/scheduler
3. Open Sources / TSO's open data or other platforms or sources of information where interval production data can be retrieved.

Also, the GC issuer validates that the stated validity level is actually true. If the issuer determines that the uploaded production data lacks sufficient reliability, the request will be rejected.

The process has also been developed to ensure that data is always validated from official sources. This avoids any issue of using non-settlement, non-rectified data for the creation of GCs.

Flexidao has extensive experience collecting measurement data through different communication protocols - both automated and manual.. A few examples of automated measurement data collection:

- Data reception (PUSH) from third-party's services (e.g. supplier's database) via API with JWT-based authorization on top of the API Key Authorization (X-API-Key in the header) mechanism or through SFTP server or MQTT.
- Data collection (PULL) from National Data Hubs through REST API (e.g. Enedis, Datadis, Energinet datahub, Elhub, etc.)
- Data collection (PULL) from OEM's cloud-based platform to collect production data through REST API (e.g. Huawei, ABB, Ingeteam, SMA, etc)
- Data collection (PULL) from OEM's MQTT service (granularity as low as seconds)
- Data collection (PULL) from OEM/Originator's SCADA service

5. GC Management for energy storage

As the energy sector evolves, the integration of energy storage systems becomes increasingly important in balancing supply and demand, stabilizing the grid, and enhancing the overall efficiency of renewable energy use. However, when it comes to the management of GCs, Flexidao has made a strategic decision not to engage in the management of GCs for energy storage at this stage.

The decision not to handle GC management for energy storage stems from several considerations:

- **Complexity of Energy Attribution:** As configuration #3 is strongly dependent on the attributes of the existing EAC systems, Flexidao has chosen to focus on direct, real-time energy generation and consumption to maintain the integrity and simplicity of its GC system.
- **Focus on Core Competencies:** Flexidao's core expertise lies in the certification of renewable energy at the point of generation. Expanding into energy storage GC management would require additional resources.
- **Regulatory and Market Uncertainty:** The regulatory framework and market practices surrounding the issuance of GCs for energy storage are still developing and can vary widely across regions. Given the current lack of defined methodologies from a regulatory perspective, Flexidao has decided to avoid potential inconsistencies associated with energy storage certification.

Flexidao is committed to staying ahead of industry changes and is prepared to adapt its offerings in line with new regulations such as 45V and REDIII. By focusing on the direct certification of renewable energy production now and remaining open to future adaptations, Flexidao ensures that its GCs continue to provide clear and reliable information to the market, with the potential to expand as the energy landscape evolves.

6. GC Validity period

The validity period of GCs is a critical aspect of their management, ensuring that the certificates accurately reflect the energy production they represent and are used within an appropriate timeframe. Flexidao is committed to maintaining the integrity and reliability of GCs by enforcing strict guidelines on their validity period, usage, and record retention. This chapter outlines the rules governing the validity of GCs, their usage in relation to energy production, and the retention of records in the GC Registry.

6.1 GC Validity Period and Alignment with Underlying EACs

GCs are not valid for a period longer than the underlying EACs they represent. This rule ensures that the GCs maintain a direct and accurate correlation with the energy production they certify. The validity of the GCs is thus inherently linked to the validity of the EACs, providing a consistent framework for energy certification and usage.

6.2 Usage of GCs in Relation to Production Period and Expiration

GCs are primarily designed to match energy production with consumption in precise, granular timeframes, often at a sub-hourly level. However, when GCs are not used in a GC Matching Claim that directly corresponds to their (sub)hourly production period, they must be utilized within the same 12-month period as the energy production they represent. If GCs are not used within this 12-month period, they will expire.

This 12-month usage window aligns the GCs with the consumption period of the associated energy, ensuring that the certificates remain relevant and accurate. Any GCs that are not utilized within this timeframe are considered expired and are no longer valid for trading or claiming purposes.

6.3 Record Retention of GCs

To ensure transparency and traceability, all records related to Issued, Transferred, Cancelled, and Expired GCs are retained in the GC Registry for a minimum of five years following their cancellation. This retention period may be extended if required by national legislation. Maintaining these records is essential for auditing, regulatory compliance, and the verification of GC claims.

The retention of these records supports the integrity of the GC system by allowing for the review and verification of certificate transactions long after they have occurred. This archival process ensures that all stakeholders can trust the historical data associated with GCs.

6.4 Treatment of Expired GCs in Domains with Residual Mix Calculations

GCs in Configuration #3 are cancelled upon issuance, eliminating the possibility of expired GCs being available for residual mix calculations.

6.5 Conclusion

The management of GC validity periods is crucial to maintaining the accuracy and reliability of energy certification. By ensuring that GCs do not outlast their underlying EACs, requiring their usage within a 12-month window, and retaining comprehensive records in the GC Registry, Flexidao upholds the integrity of the GC system. Through these practices, Flexidao continues to provide trusted and dependable certification services in the renewable energy sector.

7. IT system architecture

The following section outlines Flexidao's GC registry system architecture.

7.1 Physical Layer

The entire infrastructure is hosted on Google Cloud Platform, which offers scalable, reliable, and secure cloud services. No physical hardware is maintained locally, which minimizes risk and ensures compliance with strict regulatory requirements. By leveraging GCP's robust security features, Flexidao ensures that all data is securely stored and managed according to the highest industry standards.

7.2 Data Acquisition Layer

The data acquisition layer of our IT infrastructure primarily relies on a combination of manual uploads to the platform and a publish/subscribe (pub/sub) model. This hybrid approach allows for flexibility and control over data input processes, ensuring that critical information is captured both through user-initiated uploads and automated data streams. Manual uploads provide precise, user-driven input, while the pub/sub mechanism facilitates real-time data integration, enabling seamless updates and efficient data flow across the system. This dual strategy ensures robust data collection, catering to varied operational needs and supporting timely decision-making.

7.3 Data Management Layer

Repositories with Data Access

Data is securely stored in structured repositories on GCP, such as BigQuery, to enable fast SQL queries and analytics on large datasets. Data within the system is siloed by organization, ensuring complete segregation and compliance with privacy standards. Flexidao's registry systems strictly adhere to ISO 27001, ensuring that all data is managed in compliance with the highest security protocols.

Access Management and Data Segregation

Comprehensive access management protocols, including Know Your Customer (KYC) processes, are implemented to ensure that only authorized users have access to their specific data. This design guarantees that users from one organization cannot access or interact with the data of another organization.

7.4 Application Layer

User Interface of the Registry

A web-based interface hosted on GCP provides users with secure access to their GCs. This interface is designed to be user-friendly and is fully compliant with the forthcoming EnergyTag API data standard, ensuring seamless interoperability with other systems. Users can also request the issuance of new certificates directly through this platform.

APIs with Third-Party Services

A robust set of APIs is developed to facilitate integration with third-party services, such as energy providers, compliance bodies, and sustainability reporting platforms. These APIs are designed to be flexible, ensuring that the system can integrate future standards and protocols as they emerge, maintaining compliance with industry standards and client expectations.

7.5 Security Layer

Security is enforced at multiple levels using GCP's built-in security features, with data encryption applied both at rest and in transit. The infrastructure leverages Google Cloud Armor for DDoS protection, ensuring resilience against external threats. All security measures adhere strictly to ISO 27001, reflecting Flexidao's commitment to maintaining the highest security standards.

Monitoring and Logging

Security Information and Event Management (SIEM) tools like Google Cloud Logging and Cloud Monitoring are used for continuous monitoring and logging of all activities within the system. This ensures that any anomalies or suspicious activities are quickly detected and addressed, maintaining the integrity and security of the system.

Compliance and Auditability

The security layer is designed to comply with ISO 27001 and other relevant industry standards. All actions are logged and auditable, ensuring that the system meets regulatory requirements and provides a transparent trail for compliance audits.

This architecture ensures that Flexidao's GC registry system is secure, compliant, and scalable, while also being prepared for future interoperability standards like the EnergyTag API.

8. Fraud detection and prevention

As defined by Energytag's "GC scheme standard v2" documentation, these are the following frauds that could occur:

- **Metering data fraud at production site:** due to metering data manipulation, it could be used to request the issuance of undeserved GCs
- **Metering data fraud at consumption site:** due to metering data manipulation, it could be used to change and/or reduce/displace consumption
- **Improper amendment of registry data:** due to hacking or improper/illicit access to the registry portal
- **VAT carousel fraud:** due to the exploitation of taxation rules from different jurisdictions
- **Money laundering:** due to the use of GCs as mean to disguise funds from illicit activities
- **Market manipulation:** due to the improper/illicit use/creation of price signals on the demand or supply that could impact the overall market

In order to ensure the highest level of security and quality within the registry, Flexidao has set in place the following measures:

- **Metering data fraud at production/consumption site:** in both cases, Flexidao will always aim for validating the metering data directly from a trusted source, being it a national datahub (e.g. Energinet datahub in Denmark) or through the databases of DSOs/TSOs/ISOs, see Appendix 2.In the cases where this is not possible and the metering data comes from unofficial/untrusted sources, the GC registry will not be held responsible for any upload of erroneous data. The sole responsible will be the authorized user that submitted the document. Each authorized user will be required to ensure the accuracy of their measurement data, meaning that it needs to be settlement data.
    - **Settlement energy data** refers to records of energy production, consumption, and exchange used for financial settlements between market participants. It is reliable because it comes from certified metering systems, is subject to regulatory oversight, and is cross-validated with other data sources within the energy market. By using this data type, which is also employed in other systems, allows us to demonstrate the accuracy and trustworthiness of the data. Other data types are not eligible for GC issuance by Flexidao.
    - To verify the data's integrity, we will implement data validation and cross-checking techniques. These will involve comparing the submitted metering data against other reliable records, such as historical usage patterns or production logs, to detect any discrepancies or unusual patterns that may indicate potential fraud. This process helps ensure that the data is trustworthy, see Appendix 3.
- **Metering data fraud at data provider side:** In some markets, the party providing production data for GC issuance may not be an independent grid operator but rather a supplier with a vested interest in shaping data to favor matching results. This creates a potential conflict of interest and the risk that production data might be manipulated

before submission to Flexidao (FD) for GC issuance.The risk of data manipulation only exists if both of the following conditions are met:

- **The data supplier is also the certificate supplier (Energy suppliers and brokers).** If the data supplier (e.g., a national data hub) is not providing the buyer certificates, there is no conflict of interest.
- **The data supplier has access to consumption data.**If the data supplier is the energy supplier but has **no** access to consumption data, it cannot skew production data to benefit the matching score.

- How Flexidao prevents this:
  - **Limiting Data Manipulation: Volume Constraint**
    Flexidao ensures that the total volume of GCs issued can never exceed the total volume of EACs issued. Since EAC issuance is already verified, this cap serves as a natural limit—production data cannot be inflated beyond what is confirmed renewable energy production.
  - **Unbundled procurement**
    In unbundled procurement scenarios, the party supplying production data has no visibility into the buyer's consumption patterns. Without consumption data, they cannot manipulate production figures to artificially improve matching results.
  - PPA & Green tariffs
    Flexidao requires validation of provided meter data from PPAs with invoice data. PPA invoices include hourly data; by cross-checking these invoices against production data, any manipulation is prevented.
    For both PPA & Green tariffs, Flexidao reserves the right to inspect meter data through documentation reviews, third-party verifications or inspection reports, grid data checks, and on-site audits when necessary.

- **Improper amendment of registry data:** Flexidao has extensive security measures for mitigating security risks of registry data and technology infrastructure, see Appendix 6.
- **VAT fraud:** recognising the threat of this issue, Flexidao has implemented the following procedures:
  - The risk for VAT fraud is minimized because the registry does not allow any trading and change of ownership of the GCs.
  - KYC procedures to ensure proper user registration and access within the registry
  - Records related to Issuances, Transfers, and Cancellations will be retained on the registry for a minimum of 5 years.
- **Money laundering:** The risk of money laundering is minimized because the registry does not allow any trading and change of ownership of the GCs.
- **Market manipulation:** The risk of market manipulation is minimized because the registry does not allow any trading and change of ownership of the GCs.

9. Eligibility of Energy

Flexidao implements a robust framework to manage the eligibility and issuance of GCs in accordance with industry standards and best practices. The platform is designed to ensure that only eligible energy is certified and that the process aligns with the principles of transparency, accuracy, and reliability.

9.1 Dissemination Level of Physical Energy

Flexidao ensures that every Granular Certificate issued includes detailed information about the dissemination level of the physical energy associated with it. The dissemination level of GCs is aligned with that of EACs. These can include certificates for energy that is injected into both the public grid and local grids, as well as onsite generation.

- Public Grid-Injected Energy: This is the most common type, where energy produced by a generator is fed into a public grid, and EACs are issued to track and certify this energy's origin and attributes.
- Local Grid: EACs can also be issued for energy that is distributed within a localized grid, such as a microgrid or a private network. The energy does not need to be injected into the broader public grid to be certified.
- Onsite Generation: For energy generated and consumed onsite (e.g., solar panels on a building where the energy is used directly in that building), EACs can be issued to certify the attributes of this energy, even though it may not enter a public or local grid.

In all cases, the EACs ensure that the energy's source and attributes are tracked and verifiable, regardless of how the energy is distributed or consumed. The GC registry accepts any dissemination level that the EAC registry accepts.

9.2 Harmonization of Net Eligible Energy Production

FlexiDAO only issues certificates for **net energy production**. If a registry issues certificates based on gross production, and does not distinguish between net and gross, then no certificates are issued.

9.3 Issuance of GCs for All Primary Energy Sources

Flexidao supports the issuance of GCs for any primary energy source, allowing flexibility for producers, consumers, and regulatory bodies. The platform does not impose restrictions on the type of primary energy source eligible for certification, adhering to a neutral stance that respects the choices of all stakeholders involved. This approach allows for a broad range of energy sources to be recognized and certified, fostering inclusivity and adaptability in energy markets.

9.4 Handling of T&D Losses and Congestion

In the management of Transmission and Distribution (T&D) losses and congestion, Flexidao follows the practices established in the corresponding EAC schemes. The platform incorporates these considerations into its processes, ensuring that the impact of T&D losses and network congestion is appropriately addressed in the certification of energy. This alignment with existing schemes ensures that Flexidao's GC issuance process is consistent with industry standards and practices, maintaining the credibility and reliability of the certificates issued.

10. Error Handling for Ex-post Correction of Measurement Data

Once created, the attributes of a GC cannot be deleted or altered unless specifically requested by the owner to correct an error. In that case, Flexidao's registry will correct the error, adjusting its information to the official data collected through the registration process and from the certified sources.
Flexidao will inform the owner of the GC within 5 working days and correct the errors as fast as possible.

In case of errors during the registration process of account information, only the admin user of the organization will be allowed to change the information. Additional KYC processes will be needed depending on where the error happened.
In case of errors of measurement data reception from external sources for which too few GCs have been issued/transferred/cancelled, Flexidao's will rectify the data and issue/transfer/cancel the missing GCs.

In the management of GCs, Flexidao adheres to a rigorous protocol for handling ex-post corrections to data. We differentiate between corrections from the measurement data source and corrections from the EAC registry.

10.1 Handling Ex-post Corrections of Meter production data

While configuration #1 and #2 relies on measurement data as the primary source for GC issuance, Flexidao takes a different approach by using EAC production data as the definitive reference for certificate issuance and adjustments. On top of that, we use the proportional distribution of production data to EAC transactions. This ensures that any corrections to production data are accurately reflected in the process.

Therefore, if meter production data changes without any changes in the EAC transactions, we do not implement corrections for it.

10.2 Handling Ex-post Corrections of EAC transactions

While it is rare for an EAC to be changed after cancellation in the EAC registry, Flexidao has established a robust process to handle such occurrences effectively. These procedures ensure that any adjustments to EAC transactions are accurately reflected in the GCs (GCs) issued by the platform, maintaining the integrity of the certification process.

10.2.1 EAC Volumes Higher than Initially Recorded

In the event that corrected EAC transactions reveals higher production volumes than initially recorded, Flexidao addresses this by issuing additional GCs to cover the discrepancy. This ensures that the total number of GCs accurately reflects the corrected EAC volumes, providing a true representation of the energy produced.

10.2.2 EAC Volumes Lower than Initially Recorded

If the corrected EAC transactions shows lower production volumes, Flexidao follows a specific protocol. EACs are both issued and cancelled simultaneously, ensuring that the cancellation is correctly documented and can be used for reporting purposes.

For GCs that were issued based on the initial, incorrect EAC volumes, Flexidao subtracts the excess GCs from the production data during a comparable generation hour in the next issuance batch. This method allows for the correction of the issued volumes without requiring complex retroactive adjustments, thereby maintaining the balance of GCs in circulation.

By carefully managing these corrections, Flexidao ensures that any changes to EAC transactions, however infrequent, are seamlessly integrated into the GC issuance process. This approach maintains the accuracy of both the hourly production data and the total volume of certificates issued, preserving the trustworthiness of the GCs and the overall integrity of the platform.

Appendix 1:

Overview of Flexidao´s GC issuance in configuration #3 globally

Country	Registry name	Config #3?[2]	Comments
United States	M-RETS	✔	GCs under development[3]
United States	PJM-GATS	✔	GC issuance available by PJM-GATS. Flexidao only issues under Config #3 when no GCs have been issued for the asset and period.[4]
United States	NARR	✔	GC issuance available by NARR. Flexidao only issues under Config #3 when no GCs have been issued for the asset and period.[5]
United States	WREGIS	✔	
United States	ERCOT	✔	GCs under development
United States	NC-RETS (APX)	✔	
United States	MIRECS	✔	
United States	NEPOOL-GIS	✔	
United States	NC-RETS (APX)	✔	
United States	NVTREC	✔	
United States	NYSERDA	✔	
Canada	M-RETS & WREGIS	✔	
Mexico	Evident I-REC	✔	GCs under development
Mexico	CEL	✔	
Argentina	Evident I-REC	✔	GCs under development
Brazil	Evident I-REC	✔	GCs under development
Chile	Evident I-REC	✔	GCs under development

[2] Flexidao issues GCs in configuration #3
[3] Under development: known to be developing GC registries in either configuration #1 or #2.
[4] This can happen in several cases: developers may opt out of hourly issuance due to the perceived additional effort; they might miss issuing for certain months, resulting in a mix of TEACs and EACs; or they may start hourly issuance partway through the year, creating partial coverage. In such cases, Config #3 issuance helps fill the gaps while preserving data integrity.
[5] See 4

Chile	CER (CNE)	✔	
Colombia	Evident I-REC	✔	GCs under development
Ecuador	Evident I-REC	✔	GCs under development
Peru	Evident I-REC	✔	GCs under development
Austria	E-Control	✔	
Belgium	VREG (Flanders)	✔	GCs under development
Belgium	VREG (Wallonia)	✔	GCs under development
Belgium	VREG (Brussels)	✔	GCs under development
Croatia	HROTE	✔	
Czech Republic	OTE	✔	
Denmark	Energinet	✔	GC issuance available by Energinet. Flexidao only issues under Config #3 when no GCs have been issued for the asset and period.[6]
Estonia	Elering	✔	GCs under development
Finland	FinExtra	✔	
France	EEX	✔	
Germany	UBA	✔	
Greece	DAPEEP	✔	
Hungary	MEKH	✔	
Ireland	SEMO	✔	
Italy	GSE	✔	
Latvia	Augstpriegumatikls	✔	
Lithuania	Litgrid	✔	
Luxembourg	ILR	✔	
Netherlands	Verticer	✔	
Norway	NECS	✔	
Poland	TGE	✔	
Portugal	REN	✔	
Russia	Carbon Zero	✔	
Slovakia	OKTE	✔	
Spain	CNMC	✔	
Sweden	Energimyndigheten	✔	
Switzerland	Pronovo	✔	

[6] See 4

United Kingdom	Ofgem	✖	No GC issuance due to auxiliary load
China	GEC	✔	
Japan	Evident I-REC	✔	GCs under development
Japan	GEC	✔	
Japan	J-credits	✔	
Japan	NFC (EMSC)	✔	
South Korea	RECs (Korea Energy Agency)	✔	
South Korea	TIGR	✔	
Taiwan	Evident I-REC	✔	GCs under development
Taiwan	T-REC	✖	No GC issuance due to 15-mins based tracking system.
Taiwan	TIGR	✔	
Indonesia	Evident I-REC	✔	GCs under development
Indonesia	TIGR	✔	
Malaysia	Evident I-REC	✔	GCs under development
Malaysia	TIGR	✔	
Philippines	Evident I-REC	✔	GCs under development
Philippines	TIGR	✔	
Singapore	Evident I-REC	✔	GCs under development
Singapore	TIGR	✔	
Thailand	Evident I-REC	✔	GCs under development
Thailand	TIGR	✔	
Vietnam	Evident I-REC	✔	GCs under development
Vietnam	TIGR	✔	
India	Evident I-REC	✔	GCs under development
India	REC (CERC)	✔	
India	TIGR	✔	
Egypt	Evident I-REC	✔	GCs under development
Australia	Evident I-REC	✔	GCs under development
New Zealand	Evident I-REC	✔	GCs under development

Appendix 2:

Netherlands case: Data quality checks for settlement data

Here is an example of how sesttlement-grade data is being verified in the Netherlands. The process of verifying and calling settlement data in the energy market involves specific checks to ensure the accuracy and integrity of data used for market settlement. These checks are carried out by market participants, grid operators (such as TenneT), and data service providers. Here are the key checks performed:

1. Validation by EDSN (Energy Data Services Netherlands)

- **Data Completeness Check**: EDSN verifies that all required data points, such as meter readings for electricity and gas consumption, are provided by the Distribution System Operators (DSOs).
- **Time Series Validation**: EDSN checks the completeness of time series data for both consumption and generation, ensuring there are no missing intervals in hourly data.

2. DSO Checks (Distribution System Operators)

- **Meter Data Quality Check**: DSOs verify the accuracy of meter readings before submitting data to EDSN, including checks for irregular consumption patterns or extreme values that could indicate meter malfunctions.
- **Profile Data Validation**: DSOs validate the data against standardized consumption profiles to detect inconsistencies between measured data and expected usage patterns.

3. TenneT (Transmission System Operator) Checks

- **Aggregated Balancing Data Validation**: TenneT checks the aggregated metered data from DSOs to ensure consistency with the overall balance of electricity supply and demand in the market.
- **Reconciliation with Market Positions**: TenneT compares actual consumption and generation data against the market positions submitted by suppliers and traders to detect deviations.

4. Market Participants (Suppliers, Traders) Checks

- **Comparison with Forecasts**: Suppliers compare settlement data with their own forecasts and schedules to identify significant deviations that may affect balancing costs.
- **Validation of Allocated Volumes**: Market participants validate the allocated volumes received from EDSN against their own records to ensure accurate billing and settlement.

5. Reconciliation Process

- **Correction Rounds (e.g., D+1, M+2)**: In the Netherlands, the settlement process includes several correction rounds (e.g., D+1, M+2) where initial data is adjusted based on more accurate or late-arriving meter readings. This ensures that discrepancies are corrected before final settlement.
- **Residual Settlement Checks**: EDSN and DSOs also perform residual settlement checks to account for the difference between measured data and market positions, ensuring the correct allocation of any unaccounted energy.

Appendix 3:

Examples of use-cases proportional GC issuances

In this appendix, we provide 4 common use-case scenarios and examples of how Flexidao applies the proportional methodology for GC issuance.

Use case 1: Single Buyer Purchasing 100% of Output

In this straightforward scenario, a single buyer purchases 100% of the energy output. Since the buyer is entitled to the entire output, there is no need for proportional allocation.

Use case 2: Single Buyer Purchasing a Percentage of Output

In this case, a single buyer purchases a specified percentage of the energy output. The GCs are allocated proportionally based on the percentage of EACs purchased.

Example: Buyer Purchases 50% of Output

- **Total Monthly EACs**: 200
- **Purchased EACs**: 100 (50% of total)
- **Hourly Production Data and Resulting GCs**:

Hour	Hourly Production (kWh)	Total EACs	Purchased EACs (50%)	Resulting GCs
8	0	0	0	0
9	0	0	0	0
10	5	5	2.5	2.5
11	11.4	11.4	5.7	5.7
12	30.6	30.6	15.3	15.3
13	51	51	25.5	25.5
14	60	60	30	30

15	29.6	29.6	14.8	14.8
16	12.4	12.4	6.2	6.2
17	0	0	0	0
18	0	0	0	0
Total	**200**	**200**	**100**	**100**

Use case 3: Multiple Buyers Purchasing 100% of Output

When multiple buyers purchase 100% of the output, the GCs are allocated proportionally among them based on their purchase percentages.

Example: Buyers Split 100% Output Proportionally (40% and 60%)

- **Total Monthly EACs**: 200
- **Buyer 1 (40%)**: 80 EACs
- **Buyer 2 (60%)**: 120 EACs

Hour	Hourly Production (kWh)	Total EACs	Buyer 1 EACs (40%)	Buyer 2 EACs (60%)
8	0	0	0	0
9	0	0	0	0
10	5	5	2	3
11	11.4	11.4	4.56	6.84
12	30.6	30.6	12.24	18.36

13	51	51	20.4	30.6
14	60	60	24	36
15	29.6	29.6	11.84	17.76
16	12.4	12.4	4.96	7.44
17	0	0	0	0
18	0	0	0	0
Total	**200**	**200**	**80**	**120**

Use case 4: Multiple Buyers Purchasing a Percentage of Output

For multiple buyers purchasing a percentage of the output, the GCs are allocated proportionally based on their purchase percentages.

Example: Buyers Split 50% Output Proportionally (40% and 60%)

- **Total Monthly EACs**: 200
- **Purchased EACs**: 100 (50% of total)
- **Buyer 1 (40%)**: 40 EACs
- **Buyer 2 (60%)**: 60 EACs

Hour	Hourly Production (kWh)	Total EACs	Purchased EACs	Buyer 1 EACs (40%)	Buyer 2 EACs (60%)
8	0	0	0	0	0
9	0	0	0	0	0

10	5	2.5	2.5	1	1.5
11	11.4	5.7	5.7	2.3	3.4
12	30.6	15.3	15.3	6.1	9.2
13	51	25.5	25.5	10.2	15.3
14	60	30	30	12	18
15	29.6	14.8	14.8	5.9	8.9
16	12.4	6.2	6.2	2.5	3.7
17	0	0	0	0	0
18	0	0	0	0	0
Total	**200**	**100**	**100**	**40**	**60**

Appendix 4:

Deviations from EnergyTag standard & Rationale

Criteria ID: 1.1.35

A Measurement Body shall either be independent of production, trade and supply, OR be subject to regular independent audits to confirm the accuracy of the reported meter data.

- Flexidao deviation: The EnergyTag standard requires that measurement data be provided by a body that is independent of production, trade, and supply—or be subject to independent audits. However, our Scheme Protocol contains the following provision - Chapter 9: "In the cases where this is not possible and the metering data comes from unofficial/untrusted sources, the GC registry will not be held responsible for any upload of erroneous data."
- Rationale: While this statement deviates from the EnergyTag requirement, the deviation is acceptable for two key reasons:
    - Limiting Total Certificates: The number of EACs places a strict cap on the number of GCsthat can be issued. This ensures that no generation is over-claimed, even if the data source is not fully trusted.
    - Proportional Issuance: FlexiDAO applies a proportional issuance system. This means that, in practice, any inaccuracies in the data are systematically limited, preserving overall integrity of the certificate issuance process.
        - These safeguards collectively mitigate the risks posed by the potential use of unverified data and maintain confidence in the overall system.

Criteria ID: 1.9.1

The current controls in place in EAC Schemes shall be adopted to help prevent this type of fraud. These controls include the use of certified entities in charge of measurement and validation of production data (e.g. Transmission/Distribution System Operators), and secured channels to ensure the integrity of the data when transmitted to the GC Issuer. Although GCs require more precise data related to production (i.e. hourly profiles), the fact that measurements are done by system operators considerably reduces the risk of fraud.

- Flexidao deviation: Chapter 9 - "In the cases where this is not possible and the metering data comes from unofficial/untrusted sources, the GC registry will not be held responsible for any upload of erroneous data."
- Rationale: limitation of total certificates & proportional issuance - see as explained in Criteria ID 1.1.35. These controls collectively reduce the risk of significant errors or fraud, justifying the temporary reliance on less formal data sources

Criteria ID: 1.2.50

IF Configuration #3, The GC Issuer shall guarantee that the beneficiary, consumption period and consumption location are the same for the canceled GCs as for the canceled underlying EACs

- Flexidao deviation: Flexidao still issues GCs even when the consumption period and location are not available on a canceled EAC. In this case, the GC won´t have a consumption period of location - to make sure it aligns with the existing system.
- Rationale: In practice, we see that most registries do not require specifying the consumption period or location during EAC cancellation, so these fields are often left blank. Our scheme therefore proposes to issue GCs even when this information is missing - but still making sure all information aligns with the existing EACs. We acknowledge this deviates from the EnergyTag standard. We prioritize practical interoperability with current registry practices but remain open to stricter alignment if these fields become mandatory in future.

Criteria ID: 1.2.71

¨IF Configuration #3, the (sub) hourly consumption periods for the canceled GCs shall fall within the consumption period for the canceled underlying EACs¨

- Flexidao deviation: GCs are intended as a tool for facilitating hourly matching of energy consumption and production, and adding consumption period data to the certificate itself is not practical—especially since the underlying EACs often represent broader timeframes (e.g., monthly or annual). In keeping with conventional EAC systems, the GC issuer will not verify or process consumption data.
- Rationale: Instead, responsibility for ensuring that energy consumption is accurately matched with production falls to the Matcher and the Matching Verifier. These independent entities are charged with validating that the claims made by account holders are correct and compliant with the necessary standards.

Criteria ID: 1.5.8 - 1.5.20 (Production device registration)

- Flexidao deviation: We have included all required production device information and are making every effort to gather as many details as possible. Where certain information is currently unavailable, the requirement specifies that FD will collect it if and when it is available. See Chapter 3.3.1 - [If available]
- Rationale: Because Config #3 relies on matching production device ID with the EAC registry (the definitive source of device data and validation), any unavailable information does not materially compromise the integrity or trustworthiness of the GCs.

Criteria ID	Criteria	Rationale
1.5.8	Details of any production auxiliaries associated with the Production Device	Limited Data: Specific auxiliary details are often not shared by device owners. EAC Registry Reliance: The EAC registry verifies all critical device data.
1.5.15	Details of any payments of public support which have been made or are due in association with this Production Device, and	Confidential/Unavailable: Public support info can be confidential or not provided to us. No Impact on Integrity: This financial detail doesn't affect the energy's traceability.
1.5.16	A diagram of the Production Device, including details of the location of the entry and exit measurement point(s) for the Production Device and of any Production Auxiliaries connected to the Production Device, and	Practical Constraints: Up-to-date diagrams, especially for large or legacy sites, may be unavailable. Registry Verification: The EAC registry ensures correct measurement boundaries are validated.
1.5.17	The identity of any label scheme under which this Production Device is accredited	Registry Oversight: Label accreditations are maintained in the EAC registry. No Risk: Omission of direct label data in our system doesn't reduce certificate integrity.
1.5.19	Meter type (utility, submeter)	Undisclosed: Meter type may not be shared by the device owner. Registry Validation: The EAC registry confirms valid meter information.
1.5.20	Meter serial number	Confidential: Serial numbers can be private and withheld. Reliance on Registry: The EAC registry holds the authoritative meter identifiers, ensuring accuracy.