

# Blockchain-based Guarantees of Origin issuing platform

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**Abstract** — Guarantees of Origin (GoO) issued have the sole function of proving to a final customer that a given share or quantity of energy was produced from renewable sources. A GoO can be transferred, independently of the energy to which it relates, from one holder to another. However, with a view to ensuring that a unit of electricity from renewable energy sources is disclosed to a customer only once, double counting and double disclosure of Guarantees of Origin should be avoided [1].

For this reason, TRINITY project [2] will ensure the traceability of GoOs using a blockchain-based issuing platform (compatible with the EECS model [3]). The blockchain-based platform proposed in TRINITY, and presented in this paper, does not rely on the entire miner network to approve transactions. Instead, it uses the Federated Byzantine Agreement (FBA) algorithm, which allows a fast processing of transactions and negligible use of energy.

**Index Terms** — Blockchain, Guarantees of Origin, Issuing, Renewables, Traceability

## I. INTRODUCTION

### A. European context of Guarantees of Origin.

In Europe, the Guarantees of Origin (GoO) are issued for the purposes of providing information to the final customers on the contribution of energy from renewable and other high-efficient energy sources in an energy supplier's energy mix in accordance with Article 3(9) of Directive 2009/72/EC.

The Association of Issuing Bodies (AIB) develops, uses and promotes a European, harmonized and standardized system of energy certification for all energy carriers: the European Energy Certificate System - EECS [3]. The EECS defines a certificate as an electronic file which identifies the source and method of generation of a unit of energy (1GoO=1MWh).

According to AIB data, the market activity around GoOs is increasing. As can be seen in Fig. 1, the issues of GoO continuously increases over the years and the number of issues by October 2020 reached 700 TWh (700 million of GoO). This represents the importance that is reaching GoO in the overwhelming energy system and the important extra fount of economic benefits for Renewable Energy Sources (RES) since these GoO can be traded in bilateral or organized markets.

Annual EECS transactions by production date (TWh)

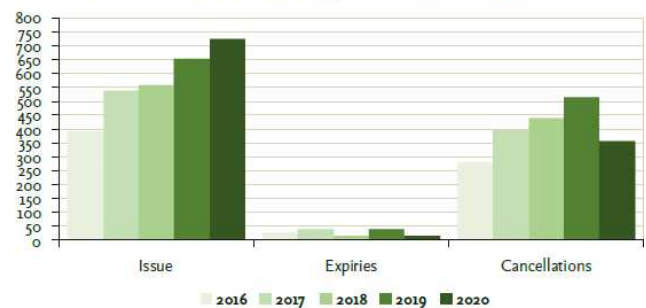


Figure 1: AIB (Association of Issuing Bodies) GoO activity [4]

### B. Gaps and potential upgrades.

Despite the growing of Guarantees of Origin (GoO) transactions, lack of transparency has been heavily criticized in the literature and it is considered to be a relevant reason for the perceived ineffectiveness of GoO in promoting renewable energy generation [5]. Apart from this, there is also the perception of double counting: possibility that an amount of renewable energy has been certified or traded twice, leading to further distrust of the system [5]. Moreover, the issuing request process lacks of automation and close to real-time processes. For example, in Spain the issuing request process is made on a manual monthly basis.

In order to solve these gaps, blockchain technology seems to be a suitable technology to be implemented since its core strengths are transparency, data auditability, privacy, value transfer, and process efficiency and automation [6]. Guarantees of Origin operations may be also accelerated and automated, issuing could have a greater degree of traceability and the transaction can be made more transparent and secure as it is permanently registered on the blockchain meaning that every actor can audit the results.

### C. Why Stellar blockchain

Stellar's basic operation is similar to that of most decentralized payment technologies. It runs a network of decentralized servers with a distributed ledger that is updated

every 2 to 5 seconds among all nodes. Stellar’s consensus protocol [7] does not rely on the entire miner network to approve transactions. Instead, it uses the Federated Byzantine Agreement (FBA) algorithm, which enables faster processing of transactions and negligible use of energy. Thus, FBA consensus helps improve the system with higher efficiency and performance translating it into high network scalability. Thus, the blockchain used in TRINITY ensures that, after the project end, the platform will be able to be used in as many regions as possible.

Like Bitcoin, Ethereum etc, Stellar transactions involve fees. What’s different is how Stellar fees are determined, and how they are used. For each transaction there is a base fee, which is a standard set by the network. The fee acts as a deterrent, ensuring that malicious actors cannot spam the network in a denial of service (DoS) attack. The base fee per operation is currently set to 0,00001 XLM (Stellar Lumens).

## II. TRINITY SOLUTION

### A. Complete TRINITY GoO ecosystem

3 software platforms coexist in the TRINITY ecosystem:

- The **GO Platform for Issuing Body**, to storage and validate operations. **It is the focus of this paper.**
- The RES Manager platform, to request GoOs for generated energy (**GO T-RES Platform**) [7].
- The trading platform (**GO T-MARKET Platform**) developed by SEEPEX and Institut Mihajlo Pupin [8]. It is mentioned in this document just to explain how the GoO Platform for Issuing Body takes GoO market results for updating its database.

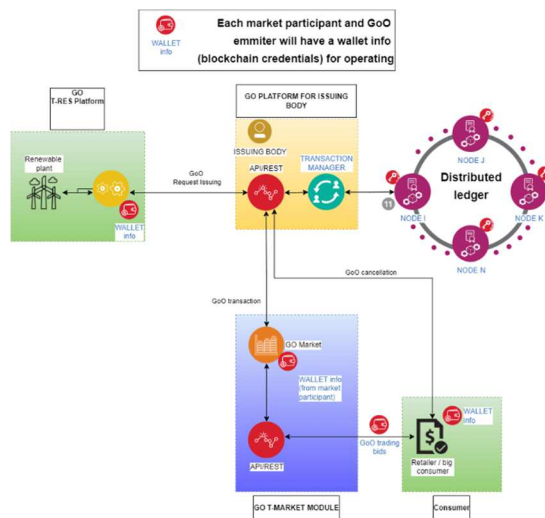


Figure 2 - TRINITY GoO Ecosystem

### B. Account Holder registration

Account Holders (AH) - such as RES Managers- shall specify at least (for issuing):

- Identity (company registration number or personal identity number, email, etc.).
- The energy source from which the energy is produced
- Type.
- Location.
- Capacity of the installation.
- Whether and to what extent the installation has benefited from investment support, whether and to what extent the unit of energy has benefited in any other way from a national support.
- Production devices information.

Internally, this process functions in the following manner:

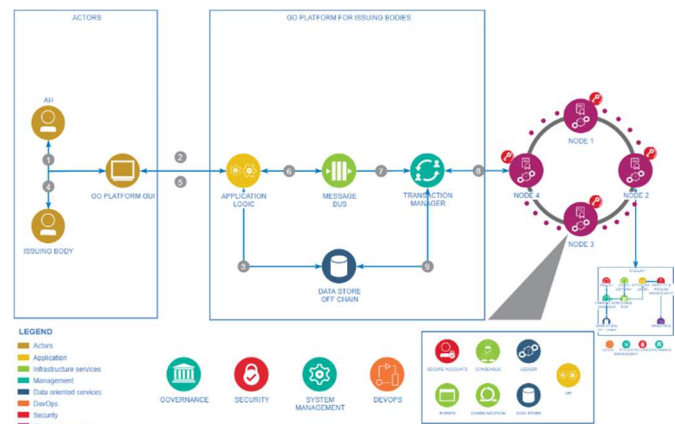


Figure 3 - Account Holder registration

1. The Account Holder registers through the GO Platform GUI.
2. Once the form is filled in with the required fields (depending on the actor), the information is sent to the backend service.
3. The registration is stored in the database waiting to be validated.
4. The Issuing Body validates the Account through the GoO Platform GUI.
5. The validation is sent to the backend service.
6. The application logic receives the validation and sends a message “Create account” to the blockchain through the message bus.
7. The registration is sent to the transaction manager.
8. A new account is created in Blockchain (Stellar)
9. This new account is stored and validated in the internal database.

### C. Issuing process

The Issuing body is continuously receiving requests for issuing GoOs from Account Holders (mainly RES producers) that have generated a certain amount of energy during a period of time. The granularity of these request will depend on the granularity decided by the Account Holder

(AH). For example, one RES producer may send the requests on a daily basis and another one on a monthly basis.

The requests will be grouped by Account Holder and by type of technology (wind, PV, hydro...). Thus, the Issuing Body will be able to easily check the validity of the request of all the GoO (1MWh=1GoO) of a single Account Holder just by clicking on the respective file and looking at the information provided in a new section (production devices involved, metering data, license information...). The Issuing Body will be able to validate or reject and issue the GoO by clicking on the respective button. This process may also work in a non-manual mode, automating it.

The Issuing Body will be also able to have a display about the historic series of data of energy issued by technology and by generating country.

Internally, this process functions in the following manner:

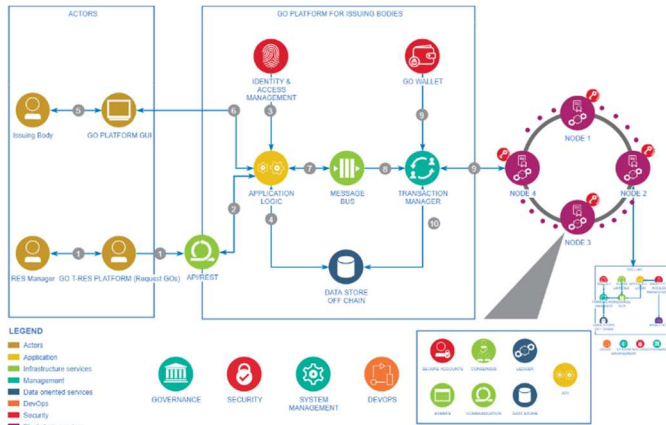


Figure 4 - TRINITY GoO issuing process

1. GoO request is sent to the GO platform for Issuing Bodies via an API/REST through T-RES platform.
2. API/REST service sends the request to the application logic.
3. The identity of the applicant is verified.
4. The issue request is stored in the internal database.
5. The Issuing Body validates the Issuing through the GO Platform GUI (can be automated).
6. The validation is sent to the backend service
7. Once the issuing is validated, the message is sent to the message bus. This message bus is required because operations in the Blockchain are much slower than local operations. The Blockchain Transaction manger is decoupled from the rest of the system, and it consumes the messages from the message bus and forwards them to the Blockchain.
8. The transaction manager creates a payment from Distribution account to the RES Manager account.
9. This payment is created in the Blockchain. A GoO is transferred to the T-RES module. AH Wallet is updated.
10. This transaction is stored in the internal database.

#### D. Transfer process

The option to trade GoOs will be made **through the GO T-MARKET Platform**. This process is needed because:

- T-Market will need GoOs Platform for Issuing Body in order to validate transactions.
- GO Platform for Issuing Body will need T-Market in order to get market transactions information and update the GoOs wallet of the Account Holders.

Internally, this process functions in the following manner (process similar to the issuing process but included here to show all the steps and the minor differences -mainly actors- between them):

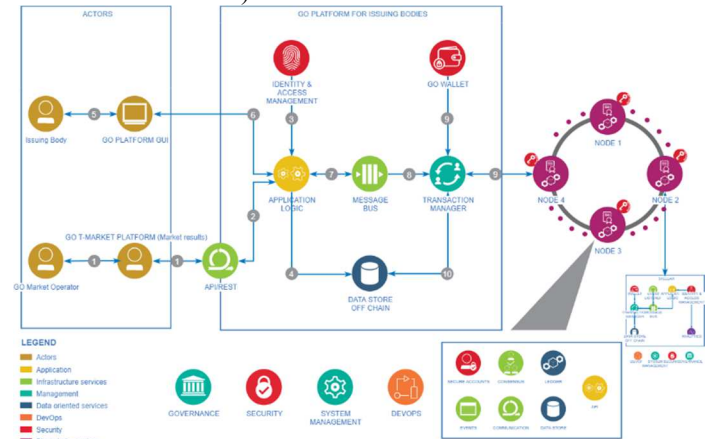


Figure 5: TRINITY GoO transfer process

1. Market results are sent to an API/REST through GO T-Market Platform.
2. API/REST service sends the request to the application logic.
3. The identity of the applicant is verified.
4. The transfer request is stored in the internal database.
5. The Issuing Body validates the Issuing through the GO Platform GUI.
6. The validation is sent to the backend service (can be automated).
7. Once the trading is validated, the message is sent to the message bus.
8. The transaction manager creates a payment from one account to the other account (traders).
9. This payment is created in the Blockchain. GoOs are transferred between AHs. Wallet of RES Manager and GoOs buyer are updated.
10. This transaction is stored in the internal database.

#### E. Cancellation, expiry and withdrawal process

The Issuing body is continuously receiving requests for cancelling GoOs from Account Holders (mainly Retailers) that have assigned the previously obtained GoOs to their end-consumers during a period of time. The granularity of these

requests will depend on the granularity decided by the Account Holder (for example, one Retailer may send the requests on a daily basis and another one on a monthly basis). The requests are grouped by Account Holder and by type of technology (wind, PV, hydro...). Thus, the Issuing Body is able to easily check the request of all the GoOs of a single Account Holder. The Issuing Body is able to validate or reject the cancellation of the GoO by clicking on the respective button.

Internally, this process functions in the following manner:

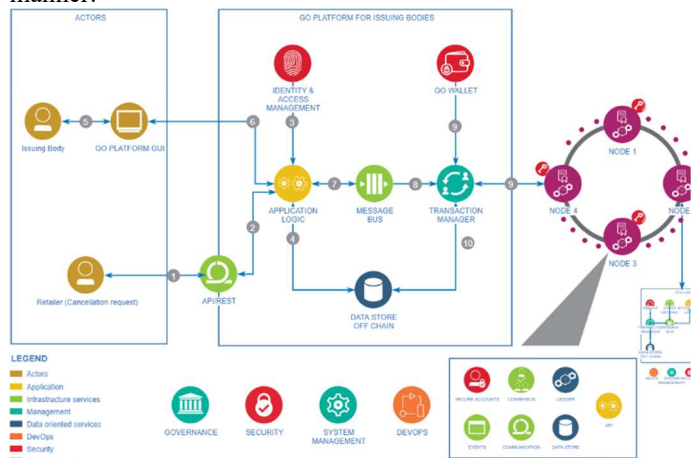


Figure 6: TRINITY GoO cancellation process

1. Cancellation request is sent to an API/REST.
2. API/REST service sends the request to the application logic.
3. The identity of the applicant is verified.
4. The cancellation request is stored in the internal database.
5. The Issuing Body validates the cancellation through the GO Platform GUI (can be automated).
6. The validation is sent to the backend service
7. Once the cancellation is validated, the message is sent to the message bus.
8. The transaction manager creates a payment from Retailer (or Account Holder that wants to cancel GoO) to the Distribution account.
9. This payment is created in the Blockchain. A GoO is cancelled. Wallet of the related Account Holder is updated.
10. This transaction is stored in the internal database.

It is noteworthy that **the withdrawal process is similar to the cancellation one and the expiry will occur automatically** since there is an internal process that every day is in charge of doing so.

### III. CONCLUSIONS

Previous chapters provided explanation on how GoOs are becoming more important and the gaps to be overcome. The platform developed under the scope of the TRINITY project aims to provide a prototype to demonstrate the potential

of Blockchain for the tracking of the lifetime of a GoO. The direct, secure and automated interconnection for data exchange between Account holders (mainly RES managers and retailers) and the Issuing Body and between the issuing body and the GoO market operator can be considered as the greatest features of this platform.

TRINITY platform will reach TRL 6/7 at the end of the project. Further developments are needed to have a complete GoO issuing platform. Although core functionalities are covered (issuing, cancellation, transfer), other functionalities such as invoicing or registration of production devices has not been considered. The demonstration activities to be performed under the scope of TRINITY project will give more insights about the benefits and further developments of the prototype needed.

Moreover, TRINITY developers see further benefits in the potential of TRINITY blockchain for facilitating further harmonization between EECs countries and support the work of the AIB.

### ACKNOWLEDGMENT

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