D-REC INITIATIVE

D-REC PLATFORM PROOF-OF-CONCEPT FUNCTIONAL SPECIFICATION

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1. Introduction

The D-REC Initiative is a private sector-led, not-for-profit, multi-stakeholder initiative seeking to develop new mechanisms to accelerate the deployment of distributed renewable energy capacity in emerging markets. It has established a taskforce across four workstreams to accomplish this: standards alignment, market advocacy, technology development, and commercial model innovation. This document focuses on a proof-of-concept for the D-REC platform (the technology workstream), which will allow distributed renewable energy (DRE) devices to participate in global environmental markets via an automated platform that will issue environmental attribute certificates (i.e. D-RECs or Distributed Renewable Energy Certificates).

The D-REC platform will serve as the hub for account and device management, and D-REC issuance, trading, and redemption. The platform will allow stakeholders to register as participants; DRE devices will be able to register as D-REC production assets. Furthermore, the platform will use generation data submitted from the devices, validate that data, and then create D-RECs which can be traded into different accounts, or redeemed directly on behalf of an entity. The D-REC Platform also will integrate with the I-REC Services registry to support the D-REC as a fractional representation of an I-REC.

1. Purpose

The purpose of this document is to outline the scenarios which will be a focus of the D-REC Proof-of-Concept (PoC). The use cases outlined in this document will be a subset of the use cases that ultimately will be supported by the platform. The purpose of the PoC will be to implement these use cases, thereby demonstrating key elements of how the D-REC platform will operate in practice.

2. Scope

This document provides a general overview of the expected software architecture, subject to revision as the PoC progresses and feedback from stakeholders is obtained,

and use cases expected to be validated through the PoC. It does not discuss specific implementation details, nor does it specify any APIs which will be exposed to 3rd-parties.

3.   Background

The D-REC Initiative is a not-for-profit, multi-stakeholder, industry-led initiative developing new ways to certify and value distributed renewable electricity (DRE) through the creation of a new, internationally-recognized market instrument called the D-REC (Distributed Renewable Energy Certificate).

Access to clean, reliable, safe and affordable energy is critical to improving the lives of the estimated 789 million people who still do not have access to electricity. DRE generates significant value for electricity end users such as households, businesses, municipal services, etc. However, the environmental and social benefits of DRE are not yet being appropriately valued, resulting in under-investment in much-needed new capacity

Renewable Energy Certificates (RECs) have become a proven mechanism to value the environmental benefits of renewable energy. Indeed, corporations who have established climate goals, and joined associations such as RE100, are seeking to power their global operations with renewable energy, and are using RECs to make verifiable claims. The goal of the D-REC Initiative is to extend the success of the RECs to the DRE sector.

5.   Assumptions and Constraints

1.   Assumptions

The following are assumed to be CTQ (Critical to Quality) for the D-REC platform:

- Supporting the creation of D-RECs from multiple DRE assets types (e.g. microgrids, mini grids, solar home systems, etc.)

- Specifying the provenance of a D-REC in a publicly verifiable manner, from the creation of the D-REC through its trading and redemption

- Supporting the integration with multiple environmental standards such as the International REC (I-REC) Standard (which will be out-of-scope for the PoC)

- Support the aggregation of D-RECs from multiple device types based on certain characteristics desired by the buyer (e.g. off-taker type, region, etc.)

These assumptions will need to be further validated based on market feedback.

2.   Constraints

The D-REC Initiative is seeking to align with several international standards, including the I-REC Standard, the Gold Standard, and VERRA. The D-REC platform will need to support many of the use cases, stakeholders, and workflows that these standards have established in order to ensure seamless integration.

6. Document Overview

This document will specify the use cases which the PoC should support; it will also outline the functional software blocks that may need to be developed in order to support these use cases.

2. Methodology

The primary purpose of the POC will be to demonstrate: 1) areas where the D-REC platform will leverage existing best practices with environmental standards, and 2) areas where the platform necessarily will need to diverge. The key elements of the POC will be:

- Account and device registry structure
- Gathering generation data via 3rd-party platform, who already have established data connections with DRE devices (either owned-devices or those of other developers)
- Creating, tracking, and redeeming D-RECs via an account structure

The POC will show that the account structure will be very similar to the existing I-REC registry model; however, the manner in which the generation data is obtained, and how it will be validated, shall be different.

3. Functional Requirements

1. Context

The D-REC platform will serve as the "single source of truth" for D-REC account and device registration, and D-REC creation, trading, and redemption. The platform will be queryable such that any market participant can view available devices and D-RECs, as well as validate the provenance of any D-REC produced by any device.

Environmental markets rely on clear ownership, provenance, and uniqueness in order to establish with certainty what environmental claims can be made by the owners of those environmental attributes. Therefore, it is of paramount importance that the D-REC platform ensure it addresses these critical market design aspects.

However, unlike the current structure of standards and markets, the D-REC platform will automate many processes to enable a more scalable and inclusive approach.

There are four key functions that the D-REC platform will offer for the PoC:

- Account registration: Allow market participants to provide information in order to engage with the D-REC platform
- Device registration: All individual DRE devices register with the D-REC platform in order to begin generating D-RECs to monetize
- D-REC creation: After receiving production data from the device (either directly from the developer or via an aggregator platform), it will validate the production data to ensure it is expected behavior for the asset, and then create a D-REC. The created D-REC will be assigned to the DRE developer's account

- D-REC trading / redemption (same only for this PoC): The platform will enable the D-REC to be moved from the account of the DRE develop to that of the buyer, after which it will be redeemed. Redemption means the D-REC will no longer be tradable

Each of these functions will be accessible via a programmatic interface.
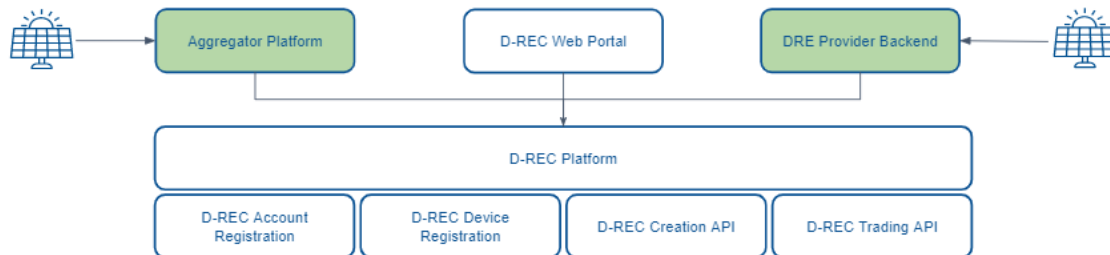
The D-REC platform will utilize a blockchain approach for recordkeeping. Certain elements of the platform will remain off-chain, such as the account and device registry structures. However, each event in the D-REC lifecycle, such as its creation, trade, or redemption, will be logged on the blockchain to ensure publicly-verifiable provenance.

2.   User Requirements

The following outlines the various PoC stakeholders and their expected roles:

3.   Market Participants

The following stakeholders are expected to play a role in the PoC

- Aggregator platform providers: These are existing market platforms that currently have digital infrastructure which connects with one or more types of DRE assets. In most cases, these platforms also have collected associated off-taker and DRE developer information. They can serve as a key data source for device and production data which can be used to create D-RECs. Indeed, DRE developers are already familiar with these platforms; their current functionality can be extended to interact with the D-REC platform

- DRE developers: In certain cases, DRE developers have developed their own digital backends to connect with DRE devices they deploy. Unlike the aggregator platform, which may serve multiple DRE developers, these digital platforms are often proprietary to the developer. The D-REC platform should still enable these market participants to programmatically interface with the platform to enable the creation of D-RECs

- D-REC Initiative: The initiative seeks to use the PoC to demonstrate key advantages to developing a digital platform that will automate the process of enabling DRE assets to engage with environmental markets. Therefore, it is important that members of the initiative can engage with the platform through a web front-end that would allow for querying available D-RECs as well as issuing trading and redemption commands (note that this will be different for the operational platform) to demonstrate the D-REC lifecycle.

- Other D-REC stakeholders not involved in the PoC:

  ○ Brokers / Marketplaces: These are digital hubs which will connect buyers with available D-RECs. They will interact with the D-REC platform programmatically to obtain available D-RECs and to issue trade or redemption commands

  ○ Financial intermediaries: These entities will invest in DRE projects, and in addition to receiving a financial return, could obtain a flow of D-RECs from those projects. The process by which these stakeholders will interact with the platform will mirror the brokers / marketplaces, with the exception of how the D-REC will be redeemed after they are produced. They may be stored in the financial intermediary's account prior to redemption

  ○ Onsite Generators: In this instance, the owner of the onsite generator will automatically redeem the D-RECs that are associated their onsite DRE asset; this use case will not be implemented in this PoC

  ○ Buyers: D-RECs ultimately will be redeemed by buyers (e.g. multinational corporations) to make publicly verifiable claims around renewable energy usage or GHG reduction. A buyer-oriented workflow, by which they will be able to browse available D-RECs and initiate transactions / redemption, will not be part of this PoC

  ○ Environmental Standards: the D-REC platform will seek to integrate with the platforms underlying several different standards, including I-REC Services from the I-REC Standard, and SustainCERT from the Gold Standard. Each may require unique integrational aspects, such as the manner in which the D-REC platform will link, D-RECs will be sent for further validation, etc. This will be out-of-scope for this POC

4.   Use Cases

4.1.   Account Registration

There are two expected ways by which an account for a participant can be created in the PoC; for this PoC, the accounts will only correspond to DRE developers and not other stakeholders such as buyers or brokers / intermediaries:

1. An aggregator platform, which already maintains account information for a DRE developer, will push this information to the D-REC platform via an API

2. A web interface to the D-REC platform can be used to set up account information for a DRE developer via a form submission

Upon receiving this information, the D-REC platform will make an entry in the data store corresponding to market participants. It will assign an ID that will be used to uniquely identify that participant. The ID will be returned as part of the function call, and will be used subsequently to associate other actions with this participant.

4.2.   Device Registration

There are two ways in which devices can be registered:

1. An aggregator platform, which already has information regarding an individual DRE device, will push that information to the D-REC platform

2. A DRE developer, through their own backend, will push device information to the D-REC platform, effectively self-registering (note: validation process will be different in this step, but will not be flushed out as part of this PoC)

3. Through a web form where a developer can enter in device information (again, validation will be critical here but is out-of-scope for the PoC)

Each device will be uniquely identified, and any subsequent call to create a D-REC will need to pass along this unique identification in order to ensure the D-REC provenance is clear.

4.3.   Instantiating D-REC

The PoC will demonstrate two ways in which data to generate a D-REC will be submitted; the third will be pending resource allocation from relevant stakeholders:

1. An aggregator platform will call into the D-REC platform when, through monitoring an individual DRE device, some electricity has been generated for a period of time. It will then send along the device identifier, the production quantity, and the period of time over which the production took place to the platform to create a D-REC

2. A form, in CSV or other format, with each line corresponding to an amount of electricity generation over a certain time period. The D-REC platform will then parse the file, verify the generation data, and then create associated D-RECs

3. Payment event from aggregator platform: in certain instances, the only data available to the aggregator will be when payment is made to enable a DRE device (e.g. solar lantern). In that instance, the generation data will need to be derived, using the capacity and the time between payment timestamps. [note: this may be a scenario that is not implemented for this version of the PoC]

The D-REC platform, upon receiving the request to create a D-REC from the monitoring period (start and stop time) and the device identifier, will then verify that the generation value is expected given the capacity, location, and age of the device. If the generation is within expectation (exact algorithm here will be defined at later date, but expect within 2 standard deviations of projected generation), then a D-REC will be created.

The D-REC creation even should be logged on the blockchain, with appropriate metadata, so provenance is clear.

Each D-REC will have a unique identifier and be associated with one or more specific devices. The active D-REC will then be assigned to the active trade account associated with the DRE developer. As an active D-REC, it will be discoverable and tradeable. Each D-REC will correspond to one kWh of electricity generation from one or more DRE devices.

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4.4. Trading D-REC

All active D-RECs will be able to move between accounts, such as from the DRE developer's account to a financial intermediary's account. For the PoC, it will be important to demonstrate how the D-REC ownership can transfer.

While the request may come in via an aggregation or intermediary's platform, for the PoC, the request will come via a web portal. The identifier for the D-REC, along with the identifier for the destination account, can be passed to the platform. The platform in turn will ensure that both identifiers are valid before assigning a new ownership identifier to the D-REC. The trade event, with the device identifier and associated accounts, should be recorded on the blockchain and be publicly available / discoverable.

4.5. Aggregating D-RECs

A key element of the D-REC platform is that it will allow the aggregation of generation data across multiple devices. This will enable smaller devices, who may not achieve the MWh of generation expected by many environmental standards, to participate in these markets as the D-REC platform will combine generation data from multiple small DRE devices to achieve sufficient scale.

Aggregators or others submitting kWh generation data for a device registered on the D-REC platform would submit such data even if it is at a Wh level. That sub-kWh data would then be available to be aggregated to a kWh-threshold; a D-REC will then be issued against the aggregated generation quantity. The D-REC platform will still validate the generation submitted for each individual device, even though only a single D-REC will be issued. The resulting D-REC will store a link back to the set of individual devices whose generation quanta was aggregated to form the D-REC.

4.6. Redeeming D-REC

In order for a buyer to make a verifiable statement around renewable energy use, a D-REC must be redeemed and no longer made available for trading. For the PoC, after the D-REC has changed ownership, it must be able to be shown as redeemed, and thus no longer available. The redemption event should be noted, and so will be a matter of public record.

5. Data Flow Diagrams

The data flow diagrams are organized along key use cases: account and device registration, creating D-RECs, and then trading/redeeming D-RECs.

## 6. **Account and Device Registration**
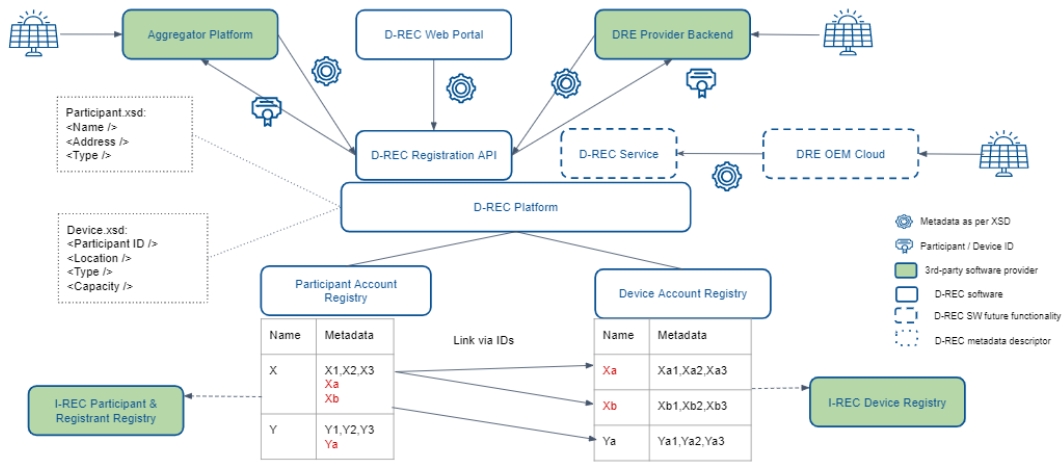
The above diagram highlights several key functional attributes:

- Registration information, both about the account and the device, can be sent via the aggregator platforms, which already have this information

- DRE developers, with their own remote monitoring backend, can submit data to the D-REC platform to register account and device information

- The information also can be submitted via a web form

Upon receiving the account and device information, the D-REC platform stores this information in the associated registries. The act of creating or registering an account is noted on the blockchain; the source of the registration information also is noted (e.g. the ID of the aggregator platform). A unique identifier is assigned to both the account and device, which will be referenced in subsequent transactions.

7. **Instantiating D-RECs**
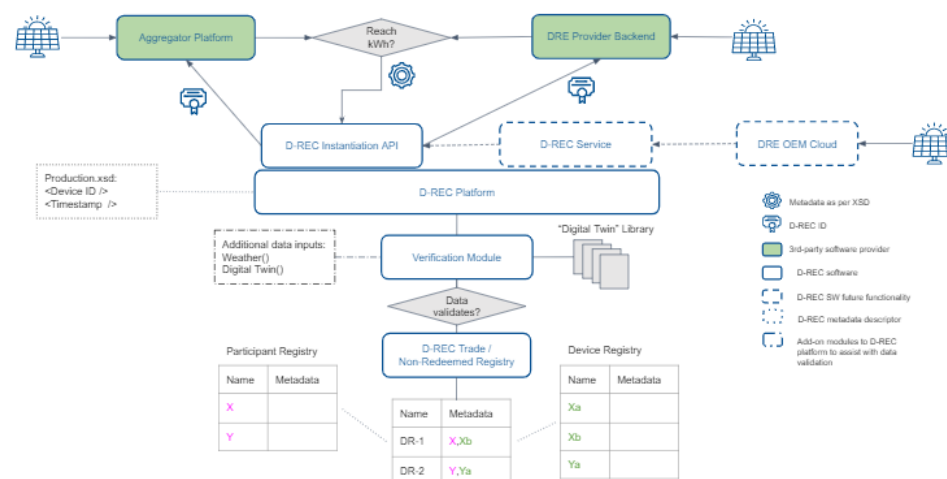
The above diagram highlights the functional elements involved in creating a D-REC:

- The request to create a D-REC can come via three entry points: aggregation platform, DRE monitoring backend, or web form (not shown)

- For the PoC, the primary mechanism will be to establish a "push" from the aggregator platform; the aggregator platform will be monitoring the DRE device, and upon generation some quanta of electricity over some period of time, will pass along the generation quantity, along with the monitoring timestamp (start and stop time) and device identifier. In the event that a "push" model cannot be implemented by the partners, the D-REC can establish a service that can pull information by querying the databases of the different partners

- Upon receiving the device identifier, the generation quanta and the monitoring start and stop timestamps, the D-REC platform will conduct a verification step to ensure that the generation quantity is within expectations. Using a "digital twin" approach, the platform can use the nameplate capacity of the device, the commissioning date, and the location to determine expected generation. If within expected range (e.g. 2 standard deviations), the D-REC can be issued – to be determined to what extent this will be implemented in the POC, but some level of a "digital twin" library and data validation should be demonstrated

- The issue D-REC is then put into an active trade account associated with the DRE developer. This D-REC can then be traded and/or redeemed

- The D-REC creation event, along with the signature of the source of the data, will be logged on the blockchain

8.   Trading D-REC
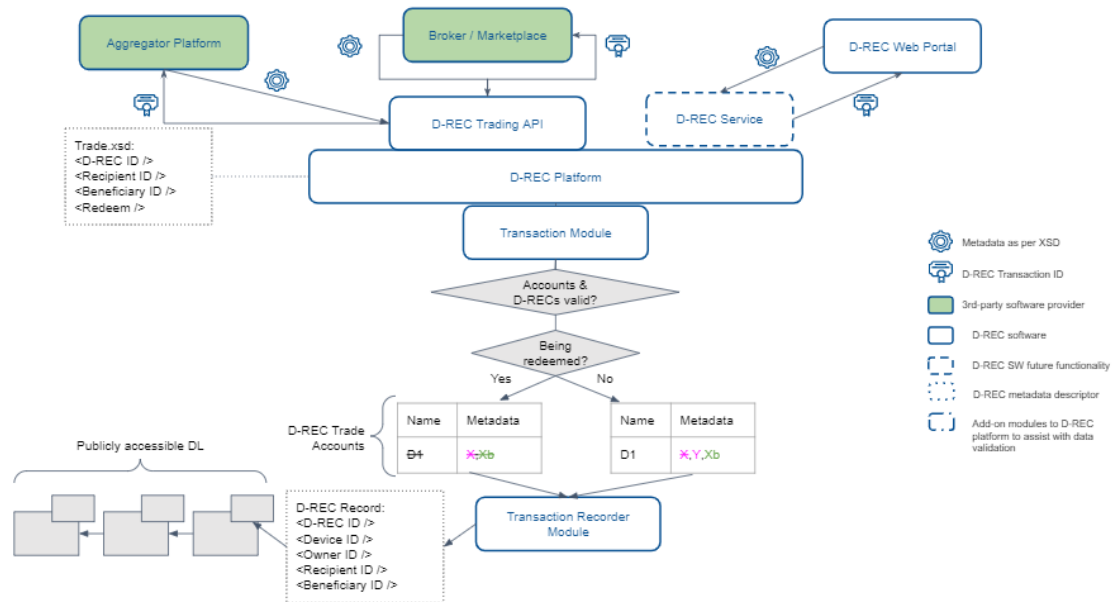
The above diagram outlines the functional elements of a D-REC transaction:

- A request to trade a D-REC from the DRE developer's account will come in via an aggregator / intermediary platform, or from the D-REC web portal

- ○ For the PoC, the focus can be on the web form which can 1) enumerate the available accounts for receiving a D-REC, and 2) assign the D-REC from the DRE developer account to the new account
- The D-REC platform will ensure the D-REC is tradeable, and the receiving account is valid, and then make the corresponding change in ownership
- The trade event is then logged on a publicly accessible ledger to denote the provenance

9. Data Repositories

There are four primary data repositories:

- Participant account registry: this will contain the information related to the market participant, such as name, address, etc. Information will be provided via a 3rd-party platform or from a web form via the D-REC web portal

- Device registry: this will contain information about the specific DRE asset that will be generating D-RECs; this will include device type, capacity, location, commissioning date. Information will come via a 3rd-party platform or via a web form in the D-REC web portal

- D-REC trade account: this will contain all D-RECs that are available for trade

- D-REC ledger: all events in the D-REC lifecycle are noted on the blockchain: account and device registration, D-REC creation, and then D-REC trade/ redemption. The source of the data (e.g. aggregation platform, web portal, etc.) will be noted for each event

4. Other Requirements

For the proof-of-concept, there should be two interfaces to the D-REC platform:

- API set by which the 3rd-party aggregators can interact with the system
- Web form by which the following actions can be taken:
  - ○ Register participate account or DRE device
  - ○ Enumerate / query available accounts, devices, or D-RECs
  - ○ Initiate a trade between two accounts, and redeem (flag on transaction)
  - ○ (Optionally) accept CSV with list of production data for D-REC creation
- The data block required to be sent via the API should be specified in a schema

5. Summary

The D-REC platform will seek to accelerate the ability of distributed renewable energy projects to engage in environmental markets by automating key elements of the certification and tracking of renewable energy certificates. Key elements of the platform will include capturing information about market participants and generation devices, and tracking the lifecycle of D-REC certificates. Using a combination of off-chain and on-

chain components, the D-REC platform will support open access for all device categories, facilitate low transaction cost certifications, and establish clear provenance and uniqueness to support global environmental standards. This Proof-of-Concept implementation will demonstrate the potential of the D-REC platform to achieve these stated objectives.

Thank you
for reading

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With funding and support from

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Shell Foundation

The D-REC Initiative is a not-for-profit, multi-stakeholder, industry-led initiative. Our membership includes climate and impact oriented philanthropic organizations, climate investors, leading global corporations, international standards organizations, technology providers, international development organizations, environmental market agents, sustainability advisors, renewable energy industry associations and project developers in emerging markets.

The Funding Partners have appointed the Secretariat to lead the coordination of the multi-stakeholder project.

Secretariat

Positive.Capital Partners

south pole