



WP2 – UPGRADING OF THE GECO2 PROJECT TOOLS

D.2.3.1 – Platform Upgrading

2.3 Upgrading of project platform

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ABSTRACT

This deliverable presents the activities carried out to upgrade the GECO 2.2 platform, available at <https://geco2.iamb.it>, as the application environment responsible for managing the complete carbon assessment workflow. The work focuses on strengthening the platform architecture that coordinates data collection, questionnaire management, validation, calculation execution, results presentation and interoperability with external systems, while keeping the scientific calculation engine clearly separated from the application layer.

The document describes the main software components supporting the operational workflow, including the integration with LimeSurvey, the management of buyer and seller processes, the implementation of REST APIs, dashboards, reporting functions and application services responsible for orchestrating the execution of the external Carbon Calculator. Particular attention is devoted to workflow governance, data validation, application traceability and the integration of external services used to improve data quality and reduce manual input.

The upgrading activities also reinforce interoperability, auditability and operational reliability through secure APIs, integrity controls and traceability mechanisms that document the complete lifecycle of each assessment.

Overall, the implemented solution provides a more robust, maintainable and interoperable platform, ensuring an efficient and transparent environment for managing carbon assessment processes while preserving a clear separation between the application platform and the external calculation engine.



2.3.1 - GECO 2.2 Platform Upgrading

Executive Summary

This deliverable illustrates the upgrading of the GECO 2.2 platform as the application environment that governs the entire workflow: data collection, questionnaire compilation, validation, calculation initiation, results presentation, export, and interoperability. The focus is not on the calculation engine itself, but on the platform layer that makes the engine usable in an organised and traceable manner.

The upgraded platform is available through the web portal <https://geco2.iamb.it>, which represents the single entry point for authorised users to access questionnaires, calculations, dashboards and reporting services.

The platform acts as the integration layer between users, companies, fields, surveys, external services, and reporting. It is here that data enters, is checked, is passed to the calculator, and then returns as consultable information. In this sense, the upgrading primarily concerns the architecture governing this process.

Objective and Scope

The objective of D.2.3.1 is to describe the platform as an application layer, rather than a computational engine. This document highlights the classes, routes, and services that compose the operational workflow, thereby demonstrating how GECO 2.2 unifies data collection, business rule checks, and results consultation.



The deliverable covers the following platform capabilities:

- Management of companies and fields;
- Creation and control of LimeSurvey questionnaires;
- Validation and preparation of data for calculation;
- Dashboards, reports, and navigation of results;
- REST APIs protected by API keys;
- Auditing, hashing, and access control.

The document should therefore be read as a description of a platform that coordinates specialised services. The calculation exists and is important, but it is treated as one of the functions orchestrated by the system, not as its sole purpose.

Application Architecture of the Platform

GECO 2.2 is built as a modular web application with dedicated PHP services for different responsibilities. The front-end manages the navigation for buyers and sellers, while the back-end enforces authorisation rules, validates data, and communicates with external services via dedicated classes. The web application is deployed at <https://geco2.iamb.it>, providing a unified environment for buyers, sellers, administrators and project stakeholders.

The main application components include SurveyService for integration with LimeSurvey, CarbonController for REST APIs, the buyer/seller calculation services for orchestrating the external engine, and the AJAX pages that implement the operational steps of survey creation, control, and processing.



Functional Block	Role in the Platform	Technical Example
Survey management	Creates, updates, and controls questionnaires	aj_create_survey.php aj_check_survey.php
Integration layer	Communicates with LimeSurvey and external services	SurveyService.php
Carbon APIs	Exposes data to third-party systems	Rest/CarbonController.php
Presentation layer	Displays results, statuses, and reports	pages/buyers pages/sellers

Questionnaire and LimeSurvey Management

One of the most visible aspects of the upgrading is the online questionnaire. The platform generates separate surveys for buyers and sellers, assigns unique tokens and URLs, and maintains the link between the application record and the external compilation. This allows the questionnaire to be treated as a native object of the platform, rather than a temporary link.



The SurveyService class encapsulates access to the LimeSurvey Remote Control API: it opens the session, queries the compilation status, exports responses, creates participants, and builds survey URLs. The AJAX flows `pages/buyers/details/aj_create_survey.php` and `pages/sellers/fields/aj_create_survey.php` use this abstraction to create the surveys and store their tokens in the database.

Key features include:

- Creation of distinct surveys for buyers and sellers;
- Use of tokens and URLs persisted on the company or field record;
- Retrieval of response status via `getParticipantStatusByToken`;
- Export of full responses for the subsequent validation phase.

The value of the upgrading lies not only in making the questionnaire an integral part of the managed workflow, but in making it part of a controlled cycle: creation, compilation, retrieval, validation, and transfer to processing.

Application Workflow and Status Checks

The platform enforces an explicit status for each record. Before processing a result, the system verifies that the survey is complete and that validation has been successful. This logic prevents the calculator from being called, or reports from being exposed, on incomplete data.

In buyer flows, the check relies on the completion and validation fields stored in the company table; in seller flows, the equivalent logic uses `company_fields`.

In both cases, the platform displays these steps through screens and explanatory messages, so that the user always understands the current status of the process.



Key features include:

- Verification of survey completion before processing;
- Distinction between errors, warnings, and confirmed status;
- Updating of application flags after each step;
- Blocking of actions that are inconsistent with the record status.

This explicit state management is a hallmark of the platform: it transforms a sequence of technical actions into a readable, governed, and reversible workflow when necessary.

External Integration Services

GECO 2.2 does not merely store manually entered data. It integrates external services to enrich the calculation context and reduce the operational burden of manual input. Climate, soil, and geospatial services are implemented and used by the platform to support the pre-compilation of the questionnaire.

This architectural choice significantly reduces manual data entry while improving the consistency of the dataset.

The data come not only from the end user, but also from technical sources that complete the profile of the field or company.

Key features include:

- Climate services for temperature, precipitation, and ET0;
- Soil and territorial information relevant to the field profile;
- Support for pre-filling questionnaire attributes;
- Greater dataset consistency prior to processing.



In terms of the deliverable, this means that the platform is not just an interface, but a system for assisted data collection and normalisation.

Dashboards, Reporting, and Consultation

The platform upgrading also includes the presentation layer. Buyer and seller pages display questionnaire status, validation status, carbon processing results, and feedback messages that guide the user through the workflow. The result is a clearer visualisation of data and application states.

At a logical level, the platform does not simply display a table: it builds summary views, statuses, and actions. Dashboards and detail tables allow the system to be read by company, by field, and by processing outcome.

Key features include:

- Summary of records and their respective application statuses;
- Consultation of calculation results for buyers and sellers;
- Operational feedback integrated into AJAX flows;
- Quick navigation to surveys, details, and outputs.

This makes the platform a true presentation layer for the process, not a simple container of raw data.

All dashboards, reports and consultation services described in this deliverable are accessible through the GECO 2.2 platform available at <https://geco2.iamb.it>.



REST APIs and Interoperability

The platform also exposes an API layer for external consultation of carbon data. The routes declared in `rest/routes/api.php` and implemented in `rest/Controllers/CarbonController.php` allow listing companies, fields, questionnaires, details, and credits via endpoints protected by API keys.

This interoperability layer is important because it separates internal data consumption from exposure to third-party systems or analytical tools. The controller does not calculate: it publishes data already governed by the platform through a well-defined API contract documented using OpenAPI.

Key endpoints include:

- `/carbon/companies` for the essential list of companies;
- `/carbon/companies/{companyId}/fields` for associated fields;
- `/carbon/companies/{companyId}/fields/{fieldId}/questionnaire` for the raw questionnaire;
- `/carbon/companies/{companyId}/fields/{fieldId}/details` and `/credits` for summary data;
- Security based on `ApiKeyMiddleware` and OpenAPI.

The presence of these endpoints reinforces the idea of a platform: data are not trapped in the UI, but are made interoperable in a controlled manner.

Traceability and Application Integrity

As with the calculator, the platform also introduces hashing and auditing mechanisms. The difference here is that traceability concerns the entire application context: who



created the questionnaire, which data were saved, which survey was completed, and which processing resulted from it.

The storage of the raw survey JSON and validation errors in dedicated fields makes it possible to reconstruct why a record was or was not processed. This is a central aspect for a system that must be verifiable and defensible in an audit.

Key features include:

- Storage of the raw survey JSON;
- Persistence of validation errors and warnings;
- Correlation between application record, user, and action performed;
- Support for integrity checks and state reconstruction.

In a platform deliverable, traceability is not an accessory: it is the mechanism that makes the process exposed to users and external systems credible.

Relationship with the Calculator

The strength of GECO 2.2 lies precisely in the division of roles: the platform governs, the calculation engine performs the computation.

`SellerCalculatorService` and `BuyerCalculatorService` handle the execution, but the interaction with the user, the questionnaire, validation, and APIs is entirely the responsibility of the application platform.



Phase	Platform Responsibility
Before the calculation	Creates the questionnaire, collects data, and verifies completeness
During the calculation	Invokes the run service and monitors the process status
After the calculation	Presents results, reports, APIs, and export

This distinction must also be maintained in document reading: D.2.3.1 does not repeat the engine's logic, but shows the system that makes it usable, monitorable, and integrated.

Results of the Upgrading

The platform upgrading has made the workflow more consistent and readable for both end users and process administrators. The questionnaire has become an object managed by the platform, external services have been integrated in an orderly manner, and results consultation has been aligned with statuses and authorisations.

Key outcomes include:

- Improved governance of the survey-validation-processing cycle;
- Greater clarity in the separation between buyer and seller;
- Documented and protected APIs for external use;
- More readable dashboards and feedback;
- Complete traceability of application activity.



The result is a more robust and maintainable platform that unites orchestration, control, and presentation without confusing the application layer with the underlying calculation engine.

Conclusions

This deliverable therefore documents the GECO 2.2 platform as a process governance environment. The references to SurveyService, CarbonController, ApiKeyMiddleware, the AJAX pages, and the REST routes serve to show the real backbone of the system, not an abstract description.

The platform upgrading has made the project more coherent, more interoperable, and more readable. The calculator remains the external engine, but it is the platform that gives it operational form and practical value.

Overall, the upgrading activities strengthened the GECO 2.2 platform by improving process orchestration, interoperability, traceability and operational reliability, while maintaining a clear separation between the application platform and the external calculation engine.

The upgraded platform described in this deliverable is operational and accessible through <https://geco2.iamb.it>. It provides a unified environment for questionnaire management, calculation orchestration, reporting, interoperability and carbon credit management, representing the operational implementation of the GECO 2.2 project objectives.

