EGDC Case study – Future Intelligence

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Case Study Methodology

EUROPEAN GREEN DIGITAL COALITION

Funded by the European Union

1 Introduction

The European Green Digital Coalition (EGDC) is an initiative of companies, supported by the European Commission and the European Parliament, based on the request of the EU Council, which aims to harness the enabling emission-reducing potential of digital solutions on all other sectors.

The main aim of the EGDC is to maximise the sustainability benefits of digitalisation within the ICT sector, while supporting sustainability goals of other key sectors such as energy, transport, agriculture, and construction. The Coalition recognises the need for science-based methods to estimate the reduction and avoidance of greenhouse gas (GHG) emissions by specific ICT solutions across sectors. This will accelerate the sustainability and circular transitions of these sectors while contributing to an innovative, inclusive, and resilient society.

To support the EGDC, a set of case study calculators are developed to provide a practical example of calculating the net carbon impact of a green digital solution in line with the European Green Digital Coalition (EGDC) methodology. This work aims to support the members of the EGDC with Action 2 of the EGDC Declaration.

This case study methodology accompanies the '*Future Intelligence* – QUHOMA' case study calculator and provides further details, additional context and transparency around the case study calculator to ensure the outcomes of the case study are interpreted and used correctly.

Disclaimer for European Parliament Pilot Project – European Green Digital Coalition (EGDC) Case Studies

The following disclaimer is intended to provide clarity and context for the case studies prepared as part of the EP Pilot Project, which have showcased the net carbon impact of specific digital solutions using the EGDC ICT Methodology developed during the project:

1. Purpose of the Case Studies:
The case studies served multiple purposes, including:

- **Development of the Methodology:** They contributed to the development of the EGDC ICT Methodology. These case studies were conducted concurrently with the methodology's creation and served as a valuable testing ground for its initial formulation.
- **Application Examples:** They provided practical examples of how the methodology can be applied to real-life use cases. These case studies were essential in demonstrating the practicality and effectiveness of the methodology when applied to concrete situations.
- **Identification of Improvement Areas:** By conducting these case studies, we aimed to highlight parts of the calculation in need of improvement. They shed light on the challenges and limitations inherent in using available data and indicated the necessary steps to move towards best practices in assessing net carbon impacts.

2. Data Quality as a Key Determinant:
It is imperative to emphasize that data quality is a fundamental determinant of the quality and reliability of the case studies. The accuracy and completeness of the data used significantly influence the outcomes and findings of these case studies.
It is essential to acknowledge that the data available for each case study may differ in terms of accuracy, granularity, and coverage. As a result, the case studies may not necessarily represent the best practice application of the EGDC ICT Methodology. Instead, they reflect the application of the methodology at various stages of data availability.

3. Liability for Errors/Omissions:
While reasonable steps have been taken to ensure that the information contained within the case studies is correct, the EGDC gives no warranty and makes no representation as to its accuracy. We accept no liability for any errors or omissions that may be present in the case studies, methodology, or related information. Users and readers are advised to exercise their judgment and seek further clarification if needed, as the information provided may evolve over time and depend on external factors beyond our control.

4. Appropriate Use of the Case Study Calculators:
The case study calculators are intended for educational and informational purposes. They rely on certain assumptions and input data to generate results.
The results of the calculators are specific to the implementation of the ICT solution and may not be representative for other implementation contexts.
As such, it is imperative for users to refrain from directly extrapolating these results to ICT solutions or implementation contexts that may seem conceptually similar.
Instead, users are advised to use the calculators as a means to understand the practical application of the EGDC ICT Methodology, thereby equipping themselves with the knowledge required to develop customized calculators specifically tailored to their unique ICT solutions and implementation circumstances.

In conclusion, these case studies provide valuable insights into the calculation of the net carbon impact of digital solutions through the practical application of the EGDC ICT Methodology. However, it is vital to exercise caution when interpreting the results, considering the variances in data quality and the evolving nature of the methodology. The findings are indicative of the methodology's potential and its room for refinement as we work towards more accurate and comprehensive assessments of net carbon impacts.

2 Results

ICT Solution and assessment overview	Quantified impacts	
QUHOMA is a Smart farming solution which uses IoT sensors and (open-source) software to mitigate the impact of changing weather conditions on crops. By remotely understanding the agri-environmental conditions of the microclimate in various parcels, the farmer can treat plots differently and optimise according to the current and forecasted weather conditions. This case study is an ex-post assessment carried out in Sparta, Greece, collecting data for different periods based on the different crop harvesting seasons.	**Net carbon impact per ha:**	-484.00 kgCO2e/cultivation cycle
	Organisational contribution	
	Future Intelligence worked to innovate, develop, and deploy the solution. This aligns with A-level classification as defined by ITU-T L.1480 (contribution of the integrated solution or the innovation of the solution).	

Quantified impacts		Other identified impacts
Assessment period:	1 Cultivation cycle	Reduction in water, electricity and fuel results in cost savings for the farmer. If all cost savings are invested into typical business carbon intensive activities, this increase in emissions could result in an estimated ~5% reduction of the total net carbon impact. This is considered as low risk. Future Intelligence should actively explore measures to ensure that cost savings are re-invested in ways that further reduce emissions rather than increase them.
Net carbon impact range:	-1.05 to -2.52 tCO2e	
Net carbon impact:	-1.59 tCO2e	

3 Methodology

Name of solution	
Assessment Objective	The purpose of this assessment is to quantify the avoided emissions from Future Intelligence solution by comparing the before and after the implementation of QUHOMA technology. The output of the assessment will demonstrate the solution's impact on water use and carbon dioxide emissions reductions. This assessment focused on one implementation context in Sparta, Greece with data collected for the crop harvesting season for olive trees. The innovative farm business that adopted this ICT solution is Olea Estates in Sparta Greece, and it voluntarily provided its aggregated farming data as in-kind contribution to this study.
Solution Description	Future Intelligence's QUHOMA is a smart farming solution which utilises sensors and software solution for data-driven irrigation and fertiliser use. Without this solution, farmers utilise excessive water which results in higher costs as well as overuse of natural scarce resources. The smart farming solution uses IoT sensors and open-source software to mitigate the impact of changing weather conditions on crops. It remotely comprehends the agri-environmental conditions of the microclimate in various parcels, optimising irrigation and fertiliser use according to current forecasted weather conditions.
Solution Boundary	The solution consists of a software solution within QUHOMA's platform. It consists of the following components: **Digital components:** • IoT IoT MicroClimate Sensor Stations (SOIL-LEAF) which senses leaf humidity and soil moisture at 2 points (locations) of farmer's interest. • IoT IoT MicroClimate Sensor Stations SOIL-PH) which senses soil pH and soil moisture. • IoT WeatherStation Sensor Station (AIR-WIND-RAIN-SOLAR) which senses information related to air humidity, wind, precipitation and solar intensity. It uses sensors to comprehend the needs of the different crops, basing it also on climate forecast for each parcel. It operates on solar panels and batteries. Each of the sensors have two lithium ion batteries.

Components of the solution in order IoT MicroClimate sensor station (SOIL-LEAF), IoT MicroClimate sensor station (SOIL-PH), IoT WeatherStation sensor station (AIR – WIND – RAIN – SOLAR)   	
Functional Unit	CO_2e emissions per hectare. This functional unit was selected as it is more suitable for this assessment than a per-kg of product basis that is typically used for these types of case studies. During the assessment period, significant pruning was required and other cultivation practices to recover tree productivity and replace some trees, which significantly reduced crop output in the solution scenario. As a result, reporting emissions per kg of product showed an artificial increase in emissions due to the unusually low yield. Therefore, the CO_2e emissions per hectare was the most suitable to provide a consistent basis for comparison between the scenarios.
Calculation Boundary	The calculation represents the farming period of three different olive grove varieties, Olea Kalamon, Olea Manaki, Olea Koutsourelia/Iadeolia. The geographic boundary of the solution is limited to Sparta, Greece where the farm implementing the solution is located. The name of the farm business is Olea Estates.

Reference scenario	In the reference scenario, Future Intelligence's farms are found within Sparta, Greece, with varying parcels and hectares depending on the olive crop variety. Agriculture practices follow conventional methods. Farmer rely on fixed schedules from previous experience to determine irrigation and use of fertiliser. Farm management relies on in person field visits.
Description of 1st order effects	The first-order effects of Future Intelligence's QUHOMA solution are related to the direct environmental impacts arising from the deployment and operation of the system's components. These include the embodied emissions, use-phase emissions, and end-of-life emissions of the solution components including: **1) Hardware components (only embodied and end-of-life emissions are considered since the sensors are battery powered)** • IoT MicroClimate Sensor Stations(SOIL-LEAF, SOIL-PH) • IoT WeatherStation Sensor Station (AIR-WIND-RAIN-SOLAR) • Two lithium ion batteries are included in the embodied emissions for each sensors. **2) Network and data transmission** • There are no gateways used as part of the solution, the connectivity (NB-IoT) is provided through existing cell towers. • Annual electricity consumption related to the energy used to transmit data between the web application and cloud/data centre via the network has been excluded due to the lack of data availability and on the basis of immateriality.
Description of 2nd order effects	The second order effects of the solution are decrease in water use, electricity use from irrigation and fuel use emissions within the farms. This is due to optimisation of water applied per hectare. More specifically: • Reduces CO_2 emissions by reducing energy consumption required for irrigation

	• Reduces CO_2 emissions by reducing water used for irrigation • Reduces CO_2 emissions by reducing fuel consumption required for regular farmer visits
Description of higher order effects	The efficient water use due to the use of Future Intelligence – QUHOMA has several indirect impacts. Future intelligence has observed a reduction in cost of electricity of 116.5euros, from 2021/2022 to 2023/2024. This is largely due to the decrease in consumption of water. The following indirect impacts are qualitative assumptions based on the reduction in water use: • Lower energy demand associated with water abstraction, treatment and distribution • Improved availability of water for other users and environmental flows • Reduce pressure on local water bodies (rivers, lakes, aquifers), potentially supporting ecosystem resilience. • Increased resilience to water scarcity or drought-related disruptions • Potential reduction in operational risk in water-stressed regions • Reduced pollutant loads entering water bodies due to lower wastewater volumes • Decreased concentration of nutrients, chemicals, and thermal pollution in receiving waters • Lower risk of eutrophication and downstream water quality degradation Another important impact of the solution is that it promotes more efficient use of fertilisers; however, this has been excluded from the calculation as different fertilisers were used in both the reference and solution scenarios. This is because after the sensor data started being collected and interpreted, the agronomist and farmer decided to change the fertiliser policy and move to fertilisers better suited to a microclimate, and specifically to this olive grove. It is therefore difficult to isolate the impact of the solution on fertiliser emissions in the current data provided. This could be assessed in the future if more data becomes available.
Mapping of all effects	

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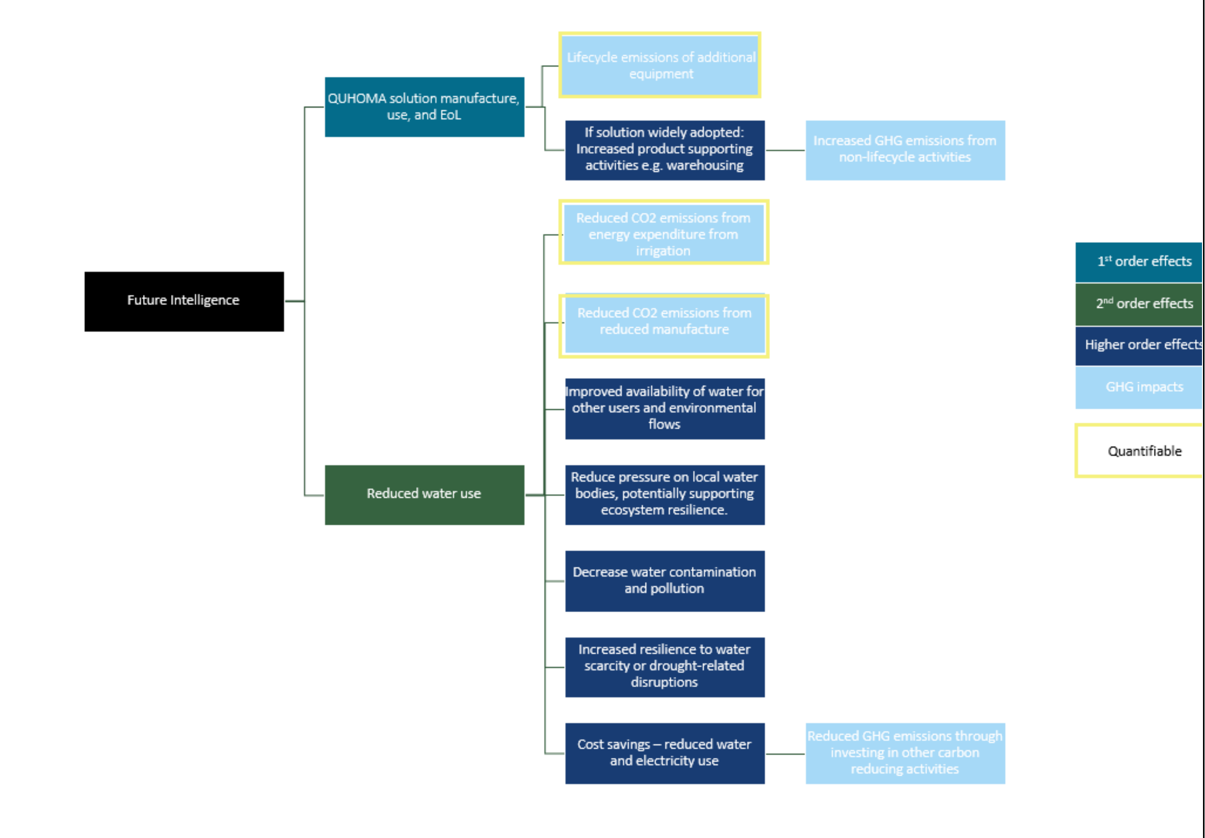

Assessing the impact of higher order effects

Effect	Quantitative Assessment	Magnitude	Likelihood	Mitigation

Cost savings due to reduced fuel, water and energy use	**Cost savings per cultivation cycle in Euros (provided by Future Intelligence):** 287 **Cost savings per cultivation cycle in USD:** $328.94 (exchange rate 30th March 2026) **EIO Factor Open CEDA (Fruit and tree nut farming – Greece):** 0.255 kgCO2e/US Dollar **Estimated emissions impact:** 83.88 kgCO2e/cultivation cycle	**Medium:** 5% of total carbon savings enabled by the solution	Somewhat likely unless cost savings are ring fenced for specific activities	Future Intelligence should explore measures to ensure that cost savings are re-invested in ways that further reduce emissions rather than increase them.

Description of calculation	**1st Order Effects** The solution emissions are calculated by summing the embodied emissions of the different sensors, batteries and solar panels, and annualized end-of-life emissions of all hardware. Embodied emissions account for the contributions from materials used in device components. End-of-life emissions are calculated by multiplying the weight of the sensors by the relevant waste emission factor. Total first-order emissions are obtained by summing up the contributions from all items including embodied and end-of-life emissions. **2nd Order Effects** The second-order effects represent the emissions avoided due to reduced water, electricity and diesel use after implementing the solution. They are calculated as the difference between the direct and indirect emissions before the solution and the direct and indirect emissions after the solution is in place. This captures the overall savings achieved by the system. **Net Carbon Impact** Net carbon impact is calculated by subtracting the first-order emissions generated by the solution itself from the 2nd order effects. This ensures that the environmental benefit accounts for the emissions embedded in the solution components, providing a more accurate measure of the net reduction in greenhouse gas emissions.

Net Carbon Saving Impact of the Solution	Net carbon savings of solution -1,594.89 $kgCO_2e$ per cultivation cycle. The solution delivered a 65% reduction in emissions.
Uncertainty and sensitivity analysis	**Total carbon savings enabled average (tCO_2e):** Calculated Net Avoided Emissions: -1.59 Lower uncertainty range: -1.05 Higher uncertainty range: -2.52 **Uncertainty analysis:** The water, diesel and electricity data of solution are the main uncertainty driver. The calculator uses an estimation surrounding carbon impact of the 2nd order effect, namely the weight and material type for each component, use phase and end of life. DESNZ conversion factors were used for the emission factors. **Sensitivity analysis:** A +/- 5% alignment to total avoided water, electricity and diesel use.
Assumptions	• No use phase due to solar panel usage. • Averages were taken for the activity data for the three different olive species • A 2 year average was taken for the activity data for the different years, in both the reference and solution scenario.
Data sources	**Data provided by Future Intelligence and the customer itself (Olea Estates):** Primary data has been provided from Future Intelligence in terms of hectarage, crop, diesel used, water consumed, electricity used for irrigation, and yield of crop. **Secondary data sources:** All secondary data sources used during calculations of the 1st order effects have been linked within the calculator

Input adjustments and key considerations for usage of results	**List of things to consider if using results in other use cases:** • Country (for the electricity grid) • Field location • Yield of crop • Field size (ha) • Electricity • Data periods
'Do no harm' criteria	Do not foresee any negative impacts on any of the EU Taxonomy's environmental nor social objectives and strongly supports objective 1. Climate change mitigation. The Future Intelligence's QUHOMA solution is scalable, while also having the potential to improve crop yield, water quality, soil health and the health of ecosystems.
Key areas for improvement	1. The most significant area of improvement is to update the case study in future years when normal production yield has returned. 2. To isolate the impact of the solution on fertiliser use, revised reference and solution scenario datasets should be used in which the type of fertiliser used is consistent across both scenarios so its affect on efficient fertiliser use can be assessed. 3. It would be more accurate to provide activity data per olive variety rather than using averages.