EGDC Case study - NEC

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Case Study Methodology

EUROPEAN GREEN DIGITAL COALITION

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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 '*NEC- CropScope*' 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

NEC's CropScope precision agriculture platform allows for data driven application of fertilisers. CropScope's Variable Rate Fertilisation (VRF) Maps enable fertiliser reduction while maintaining yields.

Without this solution, farmers utilise excessive fertilisers which results in leaching and volatilisation of nitrous oxides due overapplication of fertilisers. This leads to higher spend in fertilisers, and numerous environmental consequences to the surrounding area.

This assessment includes 3x ex-post case studies carried out by NEC in Japan, collecting data for Corn, Winter Wheat, and Spring Wheat across their harvesting seasons.

Organisational contribution

NEC 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).

Other identified impacts

The solution provides cost savings for the farmer which when invested into typical business carbon intensive activities, this could result in ~2% reduction of the total net carbon impact. This is considered as low risk and NEC are actively exploring measures to ensure that cost savings are re-invested in ways that further reduce emissions rather than increase them.

Reduced fertiliser use can also deliver benefits:

- Reduced run-off improves local water quality and reduces eutrophication that cause algal blooms and kills aquatic life.
- Nutrient pollution can disrupt the natural flora communities favouring the fast-growing species, creating consequences for both flora and fauna.
- Improved soil health, decreased acidification and salinisation as well as increase organic matter retention. Which relates to healthier ecosystems.

Quantified impacts

kgCO2e	**Corn**	**Winter Wheat**	**Spring Wheat**
Net carbon impact per kg of product:	-0.09	-0.12	-0.07
Total net carbon impact over crop season (total kg produced):	-812	-3,699	-736
Net carbon impact range:	-653 to -987	-2,953 to -4,613	-592 to -891

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3 Methodology

Name of solution	
Assessment Objective	The purpose of this assessment is to quantify the avoided emissions from NEC's CropScope solution by comparing the fertiliser use before and after the implementation of the variable rate fertilisation (VRF) technology. The output of the assessment will demonstrate the solution's impact on fertiliser use and CO_2 emissions reductions. This assessment focused on three implementation contexts in Hokkaido, Japan with data collected for different periods based on the crop harvesting season for corn, winter wheat and spring wheat.
Solution Description	NEC's CropScope precision agriculture platform allows for data driven application of fertilisers. The variable-rate fertilisation (VRF) ensures accurate fertiliser quantity while decreasing farm waste. Without this solution, farmers utilise excessive fertilisers which result in leaching and volatilisation of nitrous oxides due overapplying of fertilisers. Leading to higher spend in fertilisers, and numerous environmental consequences to the surrounding area. The VRF system includes a fertiliser broadcaster, which disperses fertilisers. Within this fertiliser broadcaster there is a mass flow controller which, based on the feedback received from satellite imagery soil nitrogen estimates and past yield data, can extrapolate the data and recommend the optimal amount of fertiliser per hectare.
Solution Boundary	The solution consists of a variable rate fertilisation functionality within CropScope's platform. It consists of the following components: **Digital components:** • Electric mass flow controller. It uses satellite imagery, soil nitrogen estimates, and past yield data to divide each field into multiple mnagement zones. It automatically generates a fertilisation map that recommends the opitmal amount of nitrogen for each zone. Farmers can view the map on a computer and connect it to compatible tractors while fertiliser applicators carry out the fertilisation automatically.
Functional Units	CO_2 emission per kg of product and CO_2 emission reduction per hectare.

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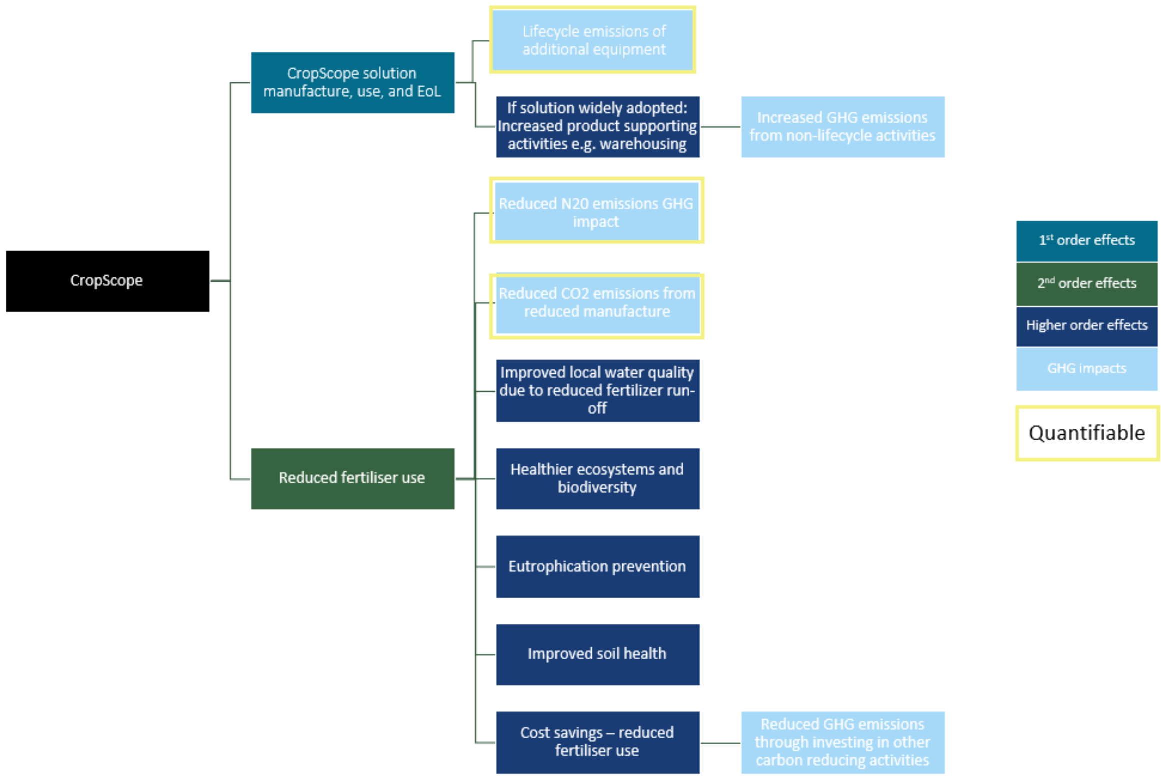
Calculation Boundary	The calculation represents the farming period per crop type: - Corn 4 months, - Winter wheat 10 months, - Spring wheat 6 months. The geographic boundary of the solution is limited to Hokkaido, Japan, where the farm implementing the solution is located.
Reference scenario	In the reference scenario, NEC's farms are found within Hokkaido, Japan, with varying hectares depending on the crop type. It operates using a guidance system which comprises a monitor and a receiver, there's an automatic steering system, and a fertiliser broadcaster which spreads the fertiliser.
Description of 1st order effects	The first-order effects of the NECs CropScope 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 hardware. A category of the components is considered for this solution: 1) **Massflow Controller** Emissions include embodied emissions of the materials that make up the massflow controller as well as the end of life. The use-phase electricity consumption during operations, which are calculated per season.
Description of 2nd order effects	The 2nd order effects of the solution are the decrease in the use of fertiliser and emissions within the farms. This is due to optimisation of nitrogen fertiliser applied per hectare.
Description of higher order effects	The decrease in fertiliser use because of the use of CropScope's VRF software has several indirect impacts. NEC has observed yield increases and reduced costs. For example, on average the price of fertiliser is 0.46$ per kilogram (World Bank, 2025), therefore on average the cost saving would be of 60$. However, initial costs will likely increase due to the introduction of the solution. The following indirect impacts are qualitative assumptions based on the reduction in fertiliser use:

- Improved local water quality, due to a reduction in fertiliser run-off. This can limit if not eutrophication causing algal blooms, killing aquatic life.
- It can decrease water contamination and pollution.
- Nutrient pollution can disrupt the natural flora communities favouring the fast-growing species, creating consequences for both flora and fauna.
- It can create improved soil health, balancing the microbial ecosystems within the soil which in place support plant growth. It can decrease acidification and salinisation as well as increase organic matter retention. Which relates all to the point above of healthier ecosystems.

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 fertiliser use	**Total fertiliser savings across all crops kg/crop season:** 782.36 Cost of fertiliser in Japan ($/kg): 0.775 (NPK Fertiliser Prices and Forecast Data Report, 2025) Estimated cost of fertiliser saved for all crops ($/crop season): 606.33 EIO Factor OPEN CEDA (Support activities for agriculture and forestry, Japan) -Link: 0.298 kgCO2e/$ Total emissions across all crops: 180 kgCO2e/ crop season	2% of total carbon savings enabled by solution could be offset, therefore low risk.	Somewhat likely unless cost savings are ring fenced for specific activities	NEC are actively exploring 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 crop cycle embodied emissions, annual use-phase emissions, and annualized end-of-life emissions of all hardware, as well as emissions related to the use of CropScope. Use-phase emissions are calculated from the seasonal electricity consumption of the monitor and of the flow mass controller multiplied by the relevant emission factor for the electricity grid. Embodied emissions account for the contributions from materials used in device components. End-of-life emissions are calculated by multiplying the weight of flow mass controller by the relevant waste emission factor. Total first-order emissions are obtained by summing up the contributions from all items including embodied, use-phase, and end-of-life emissions. **2nd Order Effects** The second-order effects represent the emissions avoided due to reduced fertiliser use after implementing the solution. They are calculated as the difference between the baseline seasonal direct and indirect emissions before the solution and seasonal direct and indirect emissions after the solution is in place. This captures the fertiliser savings achieved by the system.

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	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	**Corn**: Total net carbon impact -812 kgCO2e Net carbon impact per kg product -0.09 kgCO2e/kg **Winter Wheat**: Total net carbon impact -3,699 kgCO2e Net carbon impact per kg product -0.12 kgCO2e/kg **Spring wheat**: Total net carbon impact -736 kgCO2e Net carbon impact per kg product -0.07 kgCO2e/kg
Uncertainty and sensitivity analysis	**Uncertainty analysis:** The fertiliser quantities are the main uncertainty drivers despite the data quality being good/very good as the 2nd order effect magnitude is by far the greatest. **Corn** Total net carbon impact (Lower range): -653 kgCO2e Total net carbon impact (Higher range): -987 kgCO2e **Winter Wheat** Total net carbon impact (Lower range): -2,953 kgCO2e Total net carbon impact (Higher range): -4,613 kgCO2e **Spring Wheat** Total net carbon impact (Lower range): -592 kgCO2e Total net carbon impact (Higher range): -891 kgCO2e **Sensitivity analysis:** All crops showed the same high sensitivity to the fertiliser quantity used with +/- 5% range of results for a +/-5% input change. An alternative source of uncertainty that is not captured in the quantitative analysis is the effect of the change in yield. The yield of a crop is affected by many factors and although the solution acts to improve the yield it may not be the only factor that caused the increase in yield between the reference and solution scenarios. As the calculation considers the change in the total kg of product produced it may overestimate the

	emissions avoided by assuming that the change in yield occurs due to the solution alone.
Assumptions	**Bill of materials and components weights:** It has been assumed that the IT solution components are made of 80% plastic, 10% electronic equipment, and 10% metal. **Performance and Efficiency** Massflow controller and the monitor run at 80% efficiency.
Data sources	**Data provided by NEC:** Primary data has been provided from NEC in terms of hectarage, crop month seasonality, yield of crop as well as amount of fertiliser used. **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) • Nitrogen content • Data periods
'Do no significant 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 NEC's VRF 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. Utilising the more complex fertiliser calculation considering other criteria such as synthetic vs organic fertiliser, base of fertiliser.

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