EGDC Case study: GlobeTrack blockchain solution

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Case Study Methodology

Provided by: Atea

EUROPEAN GREEN DIGITAL COALITION

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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 to all other sectors.

The secretariat of the European Green Digital Coalition is managed by the consortium of the European Parliament Pilot Project for the EGDC, funded by the European Commission, namely the leading associations GeSI, the European DIGITAL SME Alliance, DIGITALEUROPE, ETNO and GSMA, working together with Carbon Trust, Deloitte, and Sustainable ICT Consulting.

This deliverable has been produced by the consortium of the European Parliament Pilot project for the EGDC.

Global Enabling Sustainability Initiative (Coordinator)

DIGITALEUROPE

European Telecommunications Network Operators' Association

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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 'Atea GlobeTrack' 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.

1 Methodology

GlobeTrack blockchain solution	
Assessment Objective	The assessment intent is to determine to what extent the Atea GlobeTrack solution can have a net positive impact on cold-chain transport of fish stocks based on a pilot group study. Furthermore, the aim of the assessment was also to test the EGDC ICT Sector Guidance for Net Carbon Impact Assessments and identify sector-specific methodological considerations. The assessment considers one implementation context, namely Norwegian fish cold-chain supply for a single product. The assessment is ex-ante, estimating the potential impact from future deployment opportunities in Norway using data from a pilot study.
Solution Description	GlobeTrack by Atea is a blockchain solution built on IBM's transparent supply platform that is used to track fish stock transport across cold-chain stages from Norway to a municipal district in Sweden. This tracking technology monitors food stock data metrics such as temperature, location during transport to reduce the instances of fish stock wastage due to temperature errors. This enables emissions avoidance through reduced fish stock wastage and avoided additional transport of stock across Norwegian supply chains. Overall, this solution contributes to more efficient value chains and improved food quality and traceability for customers. The solution has been trialled in district of Helsingborg, Sweden with projected deployment opportunities identified in Norway in the coming years. The assessment is limited by the geographical boundary of the pilot project. The solution was trialled in Sweden (Helsingborg). However, the solution calculation boundary covers Norwegian cold-chain transport so results may be limited by geographical representativeness. The GlobeTrack solution is expected to have an impact in the agriculture sector, specifically food distribution.

<table>
<tr>
<td>Solution Boundary</td>
<td>

Embodied (incl. transport), end-of-life and in-use emissions of hardware (cargo sensors) – lifecycle emissions
Network emissions (4G/5G) – in-use emissions
Data centre processing and storage emissions – in-use emissions
In-use emissions from laptop/mobile devices using GlobeTrack platform

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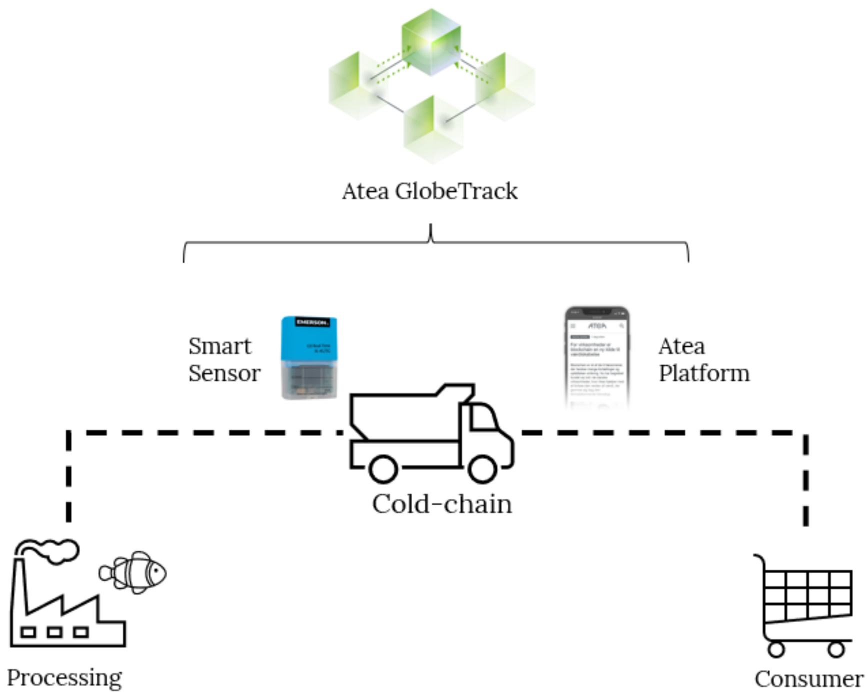

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<tr>
<td>Functional Unit</td>
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The functional unit for the solution is kilogrammes of CO2 equivalent saved for a single truck journey within Norway.
The function that the ICT solution is aiming to deliver is improved efficiency of food stock delivery across cold-chain distribution stages.
The unit quantity is the number of truckloads of food stock successfully delivered.
The performance is the monitored efficiency of successful truck deliveries within a year.
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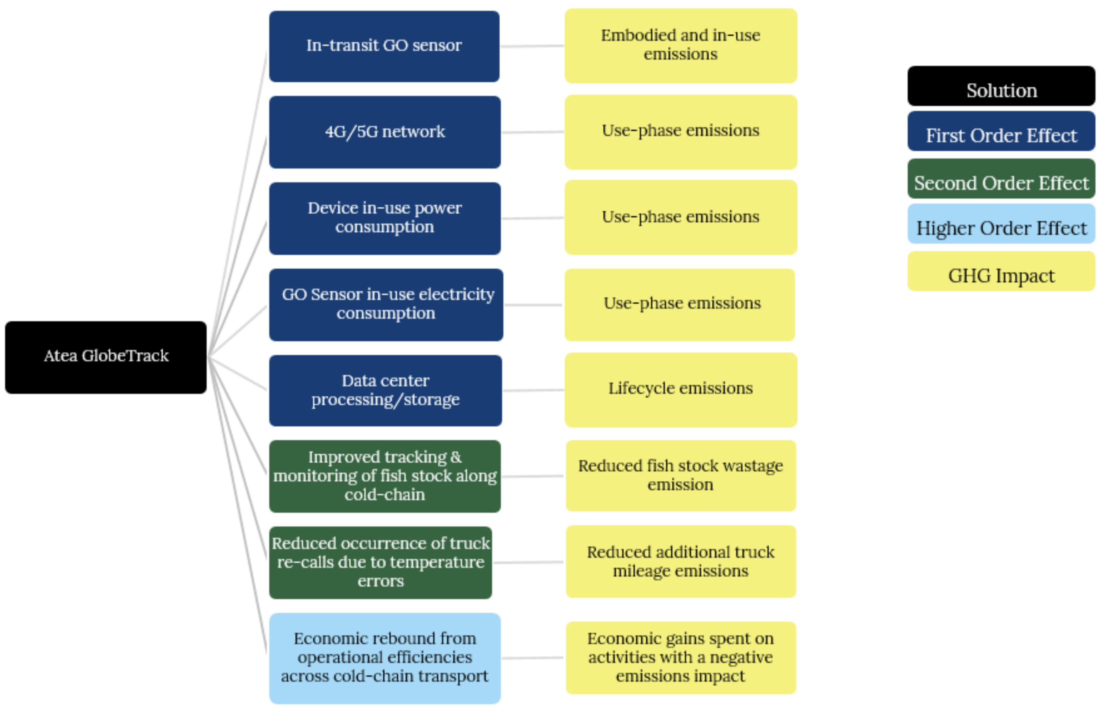
Assessment Boundary	The time boundary for the assessment is a single year, 2022. The geographical boundary for the assessment is cold-chain distribution within Norway and Sweden. The implementation context is based on a pilot study of 12 cargo trucks distributing fish to Helsingborg district, Sweden.
Reference scenario	The reference scenario considered is no active tracking of food stocks using distributed blockchain technology across cold-chain stages. This is supported by Norwegian freight distribution statistics, related to food wastage and haulage. In the reference scenario it is assumed that the tracking of food stock along cold-chain is done manually at cold-chain checkpoints. The assessment has potential to include multiple reference scenarios i.e., comparing GlobeTrack against other market-average tracking technologies. However, from secondary sources used it was not possible to split out the activity data to this level of granularity (non-tracked vs tracked freight along cold-chain). If data became available, testing multiple reference scenarios could help to improve the assessment accuracy.

Description of 1st order effects	The following emissions were identified to not be part of the reference scenario and must therefore be considered as first order effects:
	
	• **Embodied (incl. transport), end-of-life and in-use emissions of hardware** (cargo sensors) – as this hardware was not required before the implementation of the solution and is not part of the reference scenario, both the embodied and in-use emissions and should be considered for the calculation of first order effects.
	
	• **Network emissions (4G/5G)**
	
	  ○ The marginal increase in **in-use network emissions** is not part of the reference scenario and therefore should be considered for the calculation of first order effects.
	
	  ○ The **embodied (incl. transport) and end-of life emissions of the network** are already in existence even without the implementation of the solution in place, as the network is unlikely to have been upgraded solely for this solution.

	These emissions are therefore excluded from the calculation of first order effects. • **Data centre processing and storage emissions** ○ The marginal increase in **in-use emissions from data centre processing and storage** are not part of the reference scenario and therefore should be considered as first order effects. ○ It is assumed that the **embodied (incl. transport) and end-of-life emissions of datacentres used for processing and storage** are already in existence even without the implementation of the solution in place, as they are unlikely to be built solely for this solution. These emissions are therefore excluded from the calculation of first order effects. • **In-use emissions from laptop/mobile devices using GlobeTrack platform** ○ The marginal increase in **in-use emissions from laptop/mobile device power consumption** whilst accessing GlobeTrack platform is not part of the reference scenario and therefore should be considered as first order effects. ○ These emissions are therefore excluded from the calculation of first order effects due to low materiality.
Categorisation of digital technologies (A) = ICT service (B) = Service specific building block (C) = Common ICT devices, services, infrastructure	**(A)** Integrated Atea GlobeTrack Platform (blockchain) **(B)** GO Real-Time Active Sensors **(C)** Blockchain distributed servers, 4G/5G network
Description of 2nd order effects	• A reduction in fish stock wastage from pre-mature thawing along cold-chain stages. This is a result of improved monitoring and tracking through GlobeTrack platform. • A reduction in truck transport resulting from reduced occurrence of journey re-calls. Due to improved monitoring and tracking of fish

	products along cold-chain stages there is a reduced rate of temperature error detections and truck re-calls.
Description of higher order effects	**Economic rebound** Optimisation of fish stock tracking could result in a scenario where a cost saving is realised by the supplier due to more efficient cold-chain logistics. This may inadvertently drive-up demand for fish stocks due to a reduction in transport costs overheads. This scenario was identified however not quantified due to lack of available data. The magnitude and likelihood of this effect has inherent uncertainty as there was limited data available to support this. Therefore, more research into this effect should be prioritised for future recalculations.
Mapping of all effects	



Description of calculation	**1st order effects:** The 1st order emissions are derived by summation of: 1. Embodied emissions of all sensor equipment used on trucks 2. In-use emissions from powering the sensors during transport 3. In-use emissions from data centre processing and storage 4. In-use emissions from data transmission over 4G/5G network. Method for calculating each component is described below: 1. Embodied emissions of all sensor equipment used on trucks The sensors product carbon footprint could not be obtained from Atea's supplier therefore an estimated product carbon footprint (kgCO2e/sensor) was calculated using proxy materials data for a typical IoT device and apportioning the emissions by material components, using material specific emission factors for sensor plastic content and lithium-ion battery. The total embodied emissions were then derived as the summation of all sensor emissions across the deployed truck fleet. 2. In-use emissions from powering the sensors The sensor supplier could not provide power ratings data for their device so used proxy data for a typical IoT device, powered by a lithium-ion battery. The electricity consumption required to charge each sensor for a single journey was estimated. This figure was then extrapolated to the electricity consumption required to power all sensors, based on the total number of trucks journeys in a given year to give the total electricity consumption (kWh/year). A location-based emission factor was then applied to the annual consumption (kWh/year), assuming all electricity consumption originated in Sweden where the Helsingborg trial took place. 3. In-use emissions from data centre processing and storage Blockchain technology is a decentralised digital ledger meaning that all data processing is distributed across multiple geographies and data centres so is inherently complex to allocate the energy use associated to it (link). In the absence of data from Atea's data centre providers it is assumed that all energy use from the software (via blockchain) is processed through a single data centre in Norway. The recommended method to calculate use-phase emissions from the solution's network transmission would be by adopting a top-down

approach using primary data from the company's data centre provider. However, this data was not possible to obtain for the case study.

In the absence of primary data, the energy consumption was estimated using secondary source data of average energy consumption per blockchain user (digital wallet) extrapolated against the total expected number of blockchain users (assuming that the total number of users was equivalent to the total number of truck journeys/transactions in that year).

4. In-use emissions from data transmission over 4G/5G network.

In absence of primary data network transmission emissions were calculated using proxy data related to lifecycle energy intensity of network data transmission over a network access, using secondary data source and assumptions of Atea operations.

2nd order effects:

The 2nd order effects are calculated for two components of avoided emissions from implementation of solution:

1. Avoided fish wastage (tCO2e/truck/year)
2. Avoided truck transport emissions (tCO2e/truck/year)

Method for calculating each 2nd order components:

1. **Avoided fish wastage** (tCO2e/truck/year)

Typical tonnage of fish transported per year was calculated by multiplying the average tonnage of fish transported per truck by the total number of truck journeys in a given year. The calculator includes override options for both tonnage of fish stock per truck and number of truck journeys as this input greater impacts the likely emissions saving from food wastage.

Reference scenario

The reference scenario assumes that in a given year, cold-chain logistics trucks follow routine transit checkpoints along their journey for quality control produce. If after these routine checks the fish stock has thawed due a temperature error, the cargo contents will be discarded as waste and the journey abandoned. The frequency/occurrence rate of banned/recalled cold-chain trucks was estimated based on analysis of Norwegian transport statistics.

To determine the tonnage of fish stock that would typically be wasted in a given year (due to in-transit temperature errors) the total fish tonnage

	is multiplied by the occurrence rate (%) of expected truck recalls/bans to estimate the total wastage fish stock (tonnes/year). **Implementation scenario** The same calculation approach is followed for the implementation scenario, using the occurrence rate (%) of expected truck recalls when Globe Track solution is in operation (blockchain data management platform supported by in-transit active sensors in trucks). This rate was sourced from Atea's five-month trial of the solution in the Swedish district of Helsingborg. The differential between reference scenario total tonnage of fish stock wasted (tonnes/year) and from the implementation phase indicates the net avoided fish tonnage. The 2nd order emissions is then calculated using EF for food waste decomposition (kgCO2e/tonne). 2. **Avoided truck transport** (tCO2e/truck/year) **Reference scenario** This scenario assumes that in a given year a proportion of trucks are banned due to cold-chain temperature errors (without use of GlobeTrack solution), leading to the journey being abandoned and thus the kilometres travelled are wasted. The calculation assumes that a truck completes a certain proportion of the journey before is it banned/recalled (based on data from Norwegian Highways Agency). It is assumed that once a truck is banned it would then return to the origin depo to restart this journey from the origin therefore the distance travelled per truck accounts for total return journey per truck. This is calculated by multiplying the number of trucks that are banned/recalled per year (due to cold-chain temperature errors) by the average distance travelled per truck journey, the proportion (%) of journey that trucks complete before being recalled and then doubled to account for the return journey distance that trucks must travel to restart the cold-chain delivery from the original depo. **Implementation scenario** The same calculation approach is followed for the implementation scenario, using the occurrence rate (%) of expected truck recalls/bans when GlobeTrack solution is deployed in trucks (using data from Atea's Helsingborg trial). The differential of distance travelled by trucks (kilometres/year) between the reference scenario and the implementation scenario deduces the net avoided distance travelled by trucks. The 2nd order

	emissions are calculated using a distance-based EF for avoided truck distance travelled (kgCO2e/kilometre). **Net Carbon impact calculation:** The sum of 2nd order effects are subtracted from the sum of 1st order effects to get the net carbon impact (tCO2e/year).
Net Carbon Saving Impact of the Solution	**Net carbon impact**: 14.84 tCO2e / year **1st order effects**: 0.37 tCO2e / year **2nd order effects**: 15.21 tCO2e / year **Net carbon impact per functional unit**: 0.51 tCO2e / truck / year
Qualitative data uncertainty and sensitivity analysis	The uncertainty analysis assesses the quality of the data inputs. It demonstrated that the assessment's uncertainty has a significant impact on the solution's net carbon impact, given the scale of the savings. Efforts should be made to improve the activity mileage and fish stock data particularly for the reference scenario, striving to collect primary data. The sensitivity analysis shows the impact of varying the inputs to the net impact calculation in different implementation contexts. The activity data of fish stock (weight) and its associated waste emission factor are the most sensitive inputs. When the activity data for fish stock is varied by -5%, the net carbon impact decreases to 14.1 tCO2e. Alternatively when the activity data is varied by +5%, the net carbon impact increases to 15.6 tCO2e. It should be noted that the analysis performed is not a quantitative uncertainty analysis. By providing a more granular view of data quality, which builds on the data quality assessment, this analysis highlights areas of uncertainty within the calculation using a qualitative assessment framework. It can however be used to feed into a quantitative uncertainty analysis using guidance from the Greenhouse Gas Protocol on Quantitative Inventory Uncertainty: https://ghgprotocol.org/sites/default/files/2022-12/Quantitative%20Uncertainty%20Guidance.pdf
Assumptions	Key assumptions made in the calculations: • It is assumed that all claims reported due to temperature error lead to spoilt fish stock wastage, based on discussions with Atea, their fish suppliers and also lack of available data to support this claim. • Within the wider food system 17% of available food is wasted at all consumer levels e.g. households, retailers, food services etc.

	[UNEP, 2021] However, this wastage by end users further down the supply chain, after the food (fish) is delivered. Therefore falls outside the boundary of the avoided emissions calculation (not part of cold-chain transport) therefore this wastage is excluded. • Control checks for trucks are random so it is assumed that banned trucks complete no more than 8% of journey distance before stoppage (based on analysis of Norwegian Highways Agency data) • The number of truck journeys is equivalent to the truck fleet size, so each truck performs a single journey. This was the case during the Helsinbourg trial so applying this as a conservative approach. • Assumed all trucks are HGV class and refrigerated and average laden. • In the absence of data from data centre providers it is assumed that all energy use from the software (via blockchain) is processed through a single data centre in Norway.
Data sources	**1st order effects:** In-use electricity consumption for active sensors • Estimated electricity consumption per year per sensor (kWh/year) – Proxy power rating secondary sources In-use electricity consumption for software usage • Average IT Load for cloud-based blockchain software (kWh) – Secondary sources on blockchain energy intensity – link In-use energy consumption for data transmission across 4G/5G network • Emissions intensity from operation activities of 4G/5G network - link Embodied emissions of sensors • Active sensor, Bill of Materials - link **2nd order effects:** **Reference scenario - Norway** • Number of truck journeys transporting fish cargo per year - Norwegian Centre for Transport Research (2007) link • Average tonnage per truck - Norwegian Centre for Transport Research (2007) link • Proportion of trucks banned/re-called after control checks (due to temperature error) - Norwegian Truck Owners Association data set • Average distance travelled per truck - EuroStat 2021 - link • Average distance travelled before truck control/re-call, by region - Norwegian Truck Owners Association - link

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	Implementation scenario GlobeTrack Helsingborg Trial – Overview of purchases, quantities and mileage from implementation with supplier "Taste of North" (Sweden). Dataset includes: • Number of truck journeys transporting fish cargo per year • Average tonnage per truck • Average distance travelled per truck • Proportion of trucks banned/re-called after control checks Conversion factors: • BEIS 2022 Emission Factors
Input adjustments and key considerations for usage of results	Users of the calculator should consider the specific conditions that could significantly change the results of the net impact calculation. Specifically, how cold-chain transport logistics would likely differ by regions and country. The key input parameters that exert greatest influence on 2nd order effects (avoided fish stock wastage and avoided truck mileage) are listed below: o Proportion of banned/re-called truck journeys (%) o Average mileage travelled by trucks per country. o Tonnage of cargo per truck o Journeys per year To accommodate the likely variation in results the calculator includes override options for the following input parameters: o Tonnage of fish cargo per truck o Number of truck journeys per year o Average distance travelled per trucks o Truck classification and engine size
'Do no harm' criteria	Do not foresee any negative impacts on any of the EU Taxonomy's environmental nor social objectives, and supports objective 1. Climate change mitigation. GlobeTrack blockchain technology is scalable beyond Helsingborg trial scope and has the potential to improve supply chain efficiency and food quality.
Key areas for improvement	Key areas for improvement include: 1. To improve 2nd order effects calculation (highest materiality for net impact) greater focus should be placed on collection of primary activity data, specifically for the reference scenario.

	2. Tracking and measurement of data processing energy consumption would help improve the accuracy of 1st order effects calculation as currently using an estimates from secondary data. 3. The calculator should seek to include LCAs of the active sensors used on-board trucks to improve accuracy of 1st order effects calculation.

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