Appendix C – Manufacturing Sector Methodology

April 2024

EGDC ICT Methodology

EUROPEAN GREEN DIGITAL COALITION

Funded by the European Union

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, Sustainable ICT.

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

European DIGITAL SME Alliance

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Deloitte

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Sustainable ICT Consulting

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In addition, the case studies used in this methodology were received from the following organisations: Dassault Systèmes

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Introduction

To ensure the digital transition reinforces the green transition, the European Green Digital Coalition (EGDC) was formed in March 2021 supported by the European Commission and the European Parliament, based on the request of the EU Council. 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. EGDC members commit to contributing to the success of the green digital transformation of the EU and beyond by taking action in the following areas:

- To invest in the development and deployment of greener digital technologies & services that are more energy and material efficient,
- To develop methods and tools to measure the net carbon impact of green digital technologies on the environment and climate by joining forces with NGOs and relevant expert organisations, 5G
- To co-create with representatives of other sectors recommendations and guidelines for green digital transformation of these sectors that benefits environment, society, and economy.

As a cross-cutting sector, the EGDC recognises that the ICT sector can deliver emissions reductions in other sectors through the development and deployment of new solutions that would otherwise not be possible and replace existing solutions with high associated emissions.

In order to affirm, communicate and maximise the intended impact of the solutions that are being enabled by digital technologies, it is crucial that their impact is being measured in a robust and consistent way. Responding to this need and following from the EGDC Declaration, the EGDC's "Net Carbon Impact Assessment Methodology for ICT Solutions" was developed to provide a methodology for the ICT sector to develop methods and tools to measure the net impact of ICT solutions on the environment and climate.

While this methodology is sector agnostic and aims to provide a set of requirements for assessing the net carbon impact of ICT solutions in any implementation context, there are many sector-specific challenges and specificities that need to be considered. This document aims to support users of the EGDC methodology with developing net carbon impact assessments for ICT solutions implemented across different sectors, by offering a demonstration of how the individual requirements from the EGDC methodology can be applied using practical examples from sector specific case studies.

The aim of this document is therefore to demonstrate the application of the EGDC methodology for ICT solutions implemented in the manufacturing sector. To achieve this aim, the following ICT solution that has been developed into a case study calculator as part of the EGDC Pilot Project will be used:

- **DELMIA Apriso Dassault Systèmes, Operations Management** – DELMIA Apriso is a Manufacturing Operations Management/Manufacturing Execution System (MES) tool. DELMIA Apriso captures all the core functionalities of Manufacturing Execution Systems (MES), in addition to expanded Manufacturing Operations Management (MOM) capabilities. These include virtual modelling of factory floor operations and integrated quality, material synchronisation and maintenance.

While this case study does not necessarily illustrate best practice applications of the EGDC's "Net Carbon Impact Assessment Methodology for ICT Solutions", it provides a realistic application that aims to demonstrate how the methodology can be used under different circumstances. Furthermore, this document highlights where a case study has not fulfilled the criteria and details steps that would need to be taken in order for the criteria to be fulfilled.

How to use this document

This document mirrors for the most part the requirements laid out in sections 3, 4 and 6 of EGDC's "Net Carbon Impact Assessment Methodology for ICT Solutions". As such, it should be used in conjunction with the requirements and guidance laid out in the "Net Carbon Impact Assessment Methodology for ICT Solutions" and used as a reference point to illustrate how each requirement can be applied in practice for solutions in the manufacturing sector. Note that while the examples provided in these documents could be applied to other ICT solutions in this sector, they are not prescriptive and other approaches to meeting the requirements in the "Net Carbon Impact Assessment Methodology for ICT Solutions" can be applied if appropriate.

Methodology Application in the Manufacturing Sector

This section outlines all requirements in the EGDC's "Net Carbon Impact Assessment Methodology for ICT Solutions" for ICT solutions that impact emissions in the manufacturing sector. The application for each requirement is shown using an ICT solution that impacts the emissions in the manufacturing sector. Certain requirements are combined if it made sense to illustrate the application of these requirements together. This may also affect the order of the requirements in some cases.

Defining the Assessment

Assessment Objective

The assessor shall define the following:

(A) Assessment aim: Describe the intended use of the output from the assessment

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The assessment is intended to determine to what extent the DELMIA Apriso manufacturing operations management solution can have a net positive impact on the manufacturing sector when implemented in a specific context. Furthermore, the aim of the assessment was also to test the EGDC's "Net Carbon Impact Assessment Methodology for ICT Solutions" and identify sector-specific methodological considerations.

The calculator developed for the assessment considers additional manufacturing environments, for automobile and aviation production lines. Please note that when selecting these options in the calculator, results will not be aligned to the EGDC ICT methodology as calculations for these are based on secondary data.

(B) Assessment type: Define if the assessment will consider a single implementation context or if multiple contexts will be carried out.

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The assessment considers the implementation of the solution in a single context, namely the application of DELMIA Apriso to the production and quality control processes of a train manufacturer in France.

(C) Assessment perspective (actual / potential effect): Determine if an ex-post or ex-ante assessment is to be carried out.

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The ex-post assessment determines the actual effect of the ICT solution by considering the impact of the ICT solution over the project's 5-year lifetime, specifically from 2014 to 2019.

Solution Description & Boundary

The ICT solution to be assessed shall be clearly defined including:

(A) A description of the ICT solution and its functionality.

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Dassault Systèmes provides digital 3D visualisation software solutions through its 3DEXPERIENCE platform. The DELMIA brand of Dassault Systèmes is a portfolio of solutions for digital manufacturing. These solutions include digital process planning, robotic simulation, and human modelling technology.

DELMIA Apriso is a Manufacturing Operations Management/Manufacturing Execution System (MES) tool. DELMIA Apriso captures all the core functionalities of Manufacturing Execution Systems (MES), in addition to expanded Manufacturing Operations Management (MOM) capabilities. These include virtual modelling of factory floor operations and integrated quality, material synchronisation and maintenance.

(B) The key mechanism(s) by which the ICT solution is expected to result in changes to GHG emissions.

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Manufacturers can access real-time, data driven KPIs to measure productivity, better manage production lines, manage material flows, and cycle times, enhance production systems and drive real-time manufacturing processes. Carbon savings are enabled by the optimisation of manufacturing processes and early identification of faults. Most material is the reduction in product reworks required due to lower non-conformity rates which enables energy savings and reduces scrap waste.

(C) The sector(s) in which the ICT solution is expected to be implemented.

Dassault Systèmes, Operations management

The DELMIA Apriso solution is expected to have an impact across the manufacturing sector, specifically: Transportation & Mobility, Aerospace & Defence, Marine & Offshore, High Tech and Industrial Equipment.

(D) Any limitations to the use of the solution (e.g., geographical, technical, operational, etc.).

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The solution requires a connection to a 5G or 4G network and therefore is limited to locations where this infrastructure is available. Besides the requirement of connectivity to a 5G network there are no immediate boundaries to its application. A 5G network enables real-time data processing with decreased latency times and allows for greater solution efficiency, particularly for predictive maintenance solutions.

(E) The ICT solution boundary as a description of all components comprising the solution.

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Components:

- Database Server (Minimum for 10 users or less: Core i5 (6th generation) CPU (4 cores), or equivalent; 16 GB of RAM)
- DELMIA Apriso Application Server to run DELMIA Apriso applications (minimum for 10 users or less: Core i5 (6th generation) CPU (4 cores), or equivalent; 16 GB of RAM; 20 GB of free hard drive space after meeting the software requirements (50+ GB if running the database server on the same machine as DELMIA Apriso)
- Network connection
- Desktop (PC) Client (Minimum requirement: Core i3 (6th generation) CPU, or equivalent; 8 GB of RAM)
- Operating systems (Microsoft Windows Server)
- Database engines (SQL Server or Oracle environments)

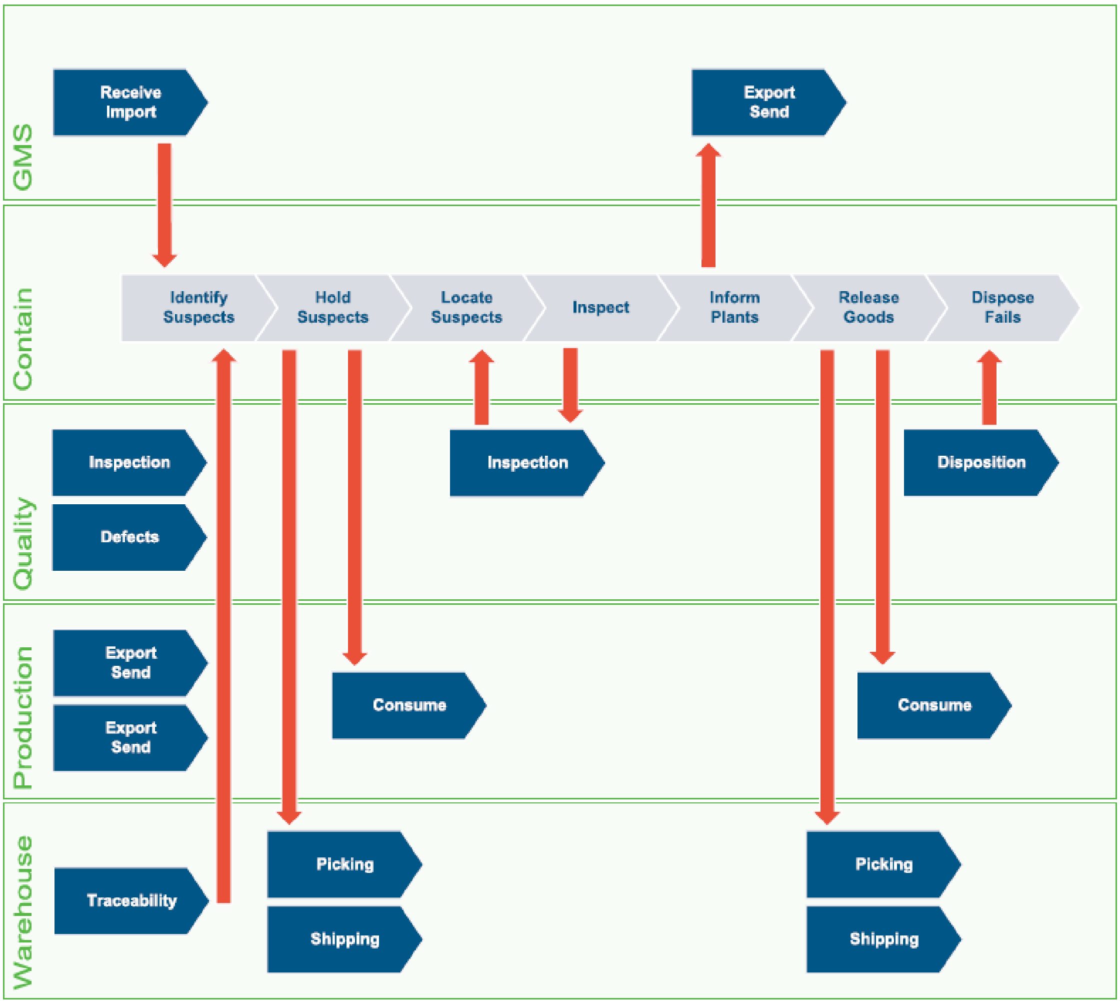
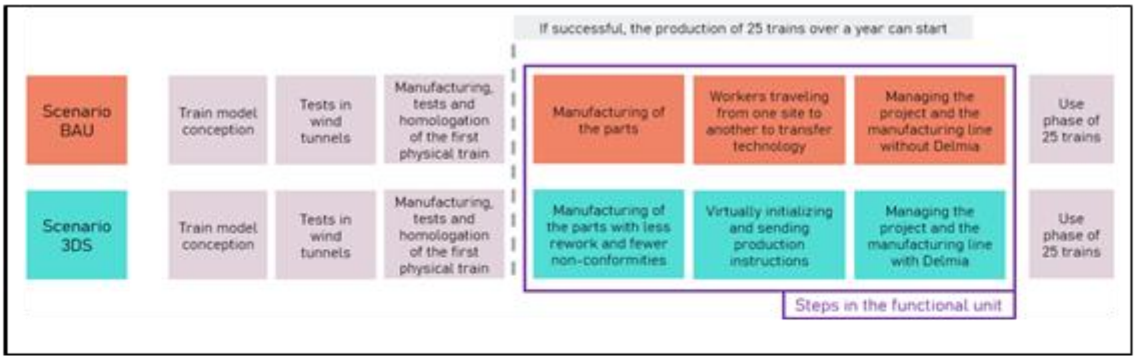


Figure 1 Containment Manager in the context of other DELMIA Apriso modules in a single plant



Functional Unit

(A) The functional unit for the assessment shall be defined including descriptions of its:

(i) Function relevant to both reference and enabled scenarios

(ii) Unit quantity

(iii) Performance

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The functional unit for the solution is **kilogrammes of CO2 equivalent saved per the vehicle manufactured.**

The unit chosen of manufactured vehicle allows the calculator to capture the annual carbon savings enabled by the solution for the vehicles produced annually by the manufacturer. This allows for comparison across manufacturers of different vehicle types.

The function that the ICT solution is aiming to deliver is the efficient manufacturing of vehicles.

The unit quantity is the number of vehicles manufactured.

The performance would be around the speed and efficiency with which the vehicles are manufactured within a year.

The functional unit was deemed suitable as the savings from each mechanism would change proportionally, as the unit changes.

Assessment Boundary

The assessment boundary determines which activities should be included in the net carbon impact assessment and therefore which emissions are included in the calculation.

(A) All GHGs covered by the Kyoto Protocol shall be included in the assessment and reported in a single CO2e value in alignment with common greenhouse gas reporting standards.

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The emission factors used to calculate the net carbon impact of the ICT solution cover all GHG emissions covered by the Kyoto Protocol and are reported in terms of CO2e. Furthermore, the well-to-tank emissions are also included in the emission factor.

(B) The assessor shall define the time boundary for the assessment.

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The time boundary for the assessment is the 5-year project lifetime covered in a study on the application of DELMIA 3DS carried out by Dassault in partnership with a third-party advisor from 2014 to 2019.

(C) The assessor shall define the geographical boundary for the assessment.

Dassault Systèmes, Operations management

The geographical boundary for this assessment is France as the initial use case provided by the solution owner is applied to the production line of a train manufacturer in France.

(D) The assessor shall define the implementation context for the assessment.

Dassault Systèmes, Operations management

The solution has been implemented in the production line in a train manufacturing site of a train manufacturer in France.

Due to data sensitivity, much of the data was estimated by the solution owner, such as the rate of non-conformity and the attribution factors (used in the solution emissions calculations).

Reference Scenario Definition

(A) The reference scenario shall be determined as what the most likely alternative scenario in the event the solution is not/was not implemented, and it shall:

(i) Have equivalent or less functionality than the ICT solution.

(ii) Be relevant to the given implementation context.

(iii) Be relevant to the time in which the ICT solution is being assessed.

(B) The most likely scenario is determined as either:

(i) Continued use of the known system that was previously in place.

(ii) Use of the average alternative solution/method that solution users would select to achieve the same service.

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Requirement (B) (i) applies as the assessment's reference scenario is known and the specific implementation context is the continued use of the known system that was previously in place.

The reference scenario chosen for the assessments corresponds to the use case provided by Dassault, produced in partnership with a third-party advisor. This use case studies the application of DELMIA Apriso to the production and quality control processes of a French train manufacturer.

The reference period before implementation is 2014 and the scope of the project lifetime included in the study is 2014-2019.

(C) The reference scenario shall include multiple scenarios if necessary to accurately represent the most likely alternative scenario.

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The reference scenario is known for the single, specific implementation context assessed which is the continued use of the known system that was previously in place.

(D) The assessor shall describe how the function is fulfilled in the reference scenario.

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The reference scenario is the average construction of trains, focusing on the production of train parts. The manufacturing steps of a train on a production line consist of manufacturing train parts, workers travelling between sites to transfer technology and the management of the project and line manufacturing. This scenario results in scrap being generated from non-conformities and reworks for faulty parts, physical demands for knowledge and resource sharing and the time involved in managing the project and production line.

Post implementation, processes are more efficient, and defaults are flagged earlier in the production process, reducing the amount of rework required on machined products and decreasing scrap waste volume.

Identifying Effects

Identifying Reference and ICT Solution Scenario Activities and Emission Sources

(A) Identify the activities under the reference and ICT solution scenarios.

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The following activities were identified as activities under both the reference and ICT enabled scenarios.

Reference scenario	ICT enabled scenario
Train model conception	Train model conception
Tests in wind tunnels	Tests in wind tunnels

Manufacturing tests and homologation of the first physical train	Manufacturing tests and homologation of the first physical train
Manufacturing of the train parts consisting of the identification, hold and location and inspection of suspects (non-conformities), informing the plants, releasing goods and the disposition of fails.	Manufacturing of the parts, including the same steps as the reference scenario but with less rework and fewer non-conformities.
Workers traveling from one site to another to transfer technology	Virtually initializing and sending production instructions

(B) Identify potential GHG emission sources related to the activities.

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Reference scenario	Potential emission sources	ICT enabled scenario	Potential emission sources
Train model conception	No emissions	Train model conception	No emissions
Tests in wind tunnels	Energy and electricity emissions from tests and test site	Tests in wind tunnels	Energy and electricity emissions from tests and test site
Manufacturing tests and homologation of the first physical train	Site emissions from manufacturing site Electricity and process emissions Embodied emissions of train parts	Manufacturing tests and homologation of the first physical train	Site emissions from manufacturing site Electricity and process emissions Embodied emissions of train parts

Manufacturing of the train parts consisting of the identification, hold and location and inspection of suspects (non-conformities), informing the plants, releasing goods and the disposition of fails.	Embodied emissions of train parts Transport emissions Electricity and process emissions from manufacturing line activities Office/Manufacturing site emissions Disposal emissions from disposition of failed parts.	Manufacturing of the parts, including the same steps as the reference scenario but with less rework and fewer non-conformities.	Embodied emissions of train parts Transport emissions Electricity and process emissions from manufacturing line activities Office/Manufacturing site emissions Disposal emissions from disposition of failed parts.
Workers traveling from one site to another to transfer technology	Transport emissions	Virtually initializing and sending production instructions	Virtual capabilities' emissions from energy use

Identifying Potential Effects of Solution Implementation

(A) Identify the potential effects generated by the implementation of the ICT solution.

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Reference scenario	**Potential emission sources**	**ICT enabled scenario**	**Potential emission sources**	**GHG emission impacts**
Train model conception	No emissions	Train model conception	No emissions	No change in emissions

Tests in wind tunnels	Energy and electricity emissions from tests and test site	Tests in wind tunnels	Energy and electricity emissions from tests and test site	No change in emissions
Manufacturing tests and homologation of the first physical train	Site emissions from manufacturing site Electricity and process emissions Embodied emissions of train parts	Manufacturing tests and homologation of the first physical train	Site emissions from manufacturing site Electricity and process emissions Embodied emissions of train parts	No change in emissions
Manufacturing of the train parts consisting of the identification, hold and location and inspection of suspects (non-conformities), informing the plants, releasing goods and the disposition of fails.	Embodied emissions of train parts Transport emissions Electricity and process emissions from manufacturing line activities Embodied and disposal emissions of scrap waste. Office/Manufacturing site emissions Disposal emissions from	Manufacturing of the parts, including the same steps as the reference scenario but with less rework and fewer non-conformities.	Embodied emissions of train parts Transport emissions Electricity and process emissions from manufacturing line activities Embodied and disposal emissions of scrap waste. Office/Manufacturing site emissions Disposal emissions from	Yes, reduction in emissions from reduced scrap waste and related embodied and disposal emissions. Reduction in emissions from energy savings arising from the optimisation of manufacturing processes and early identification of faults reducing product reworks. Increase in emissions from

	disposition of failed parts.		disposition of failed parts.	embodied and in-use emissions from software and hardware required in the installation, implementation, and use of the Delmia solution.
Workers traveling from one site to another to transfer technology	Transport emissions	Virtually initializing and sending production instructions	Virtual capabilities' emissions from energy use	Yes, reduction in transport emissions

Mapping Effects in a Consequence Tree

(A) Map out all first, second, and higher order effects and GHG impacts in a consequence tree.

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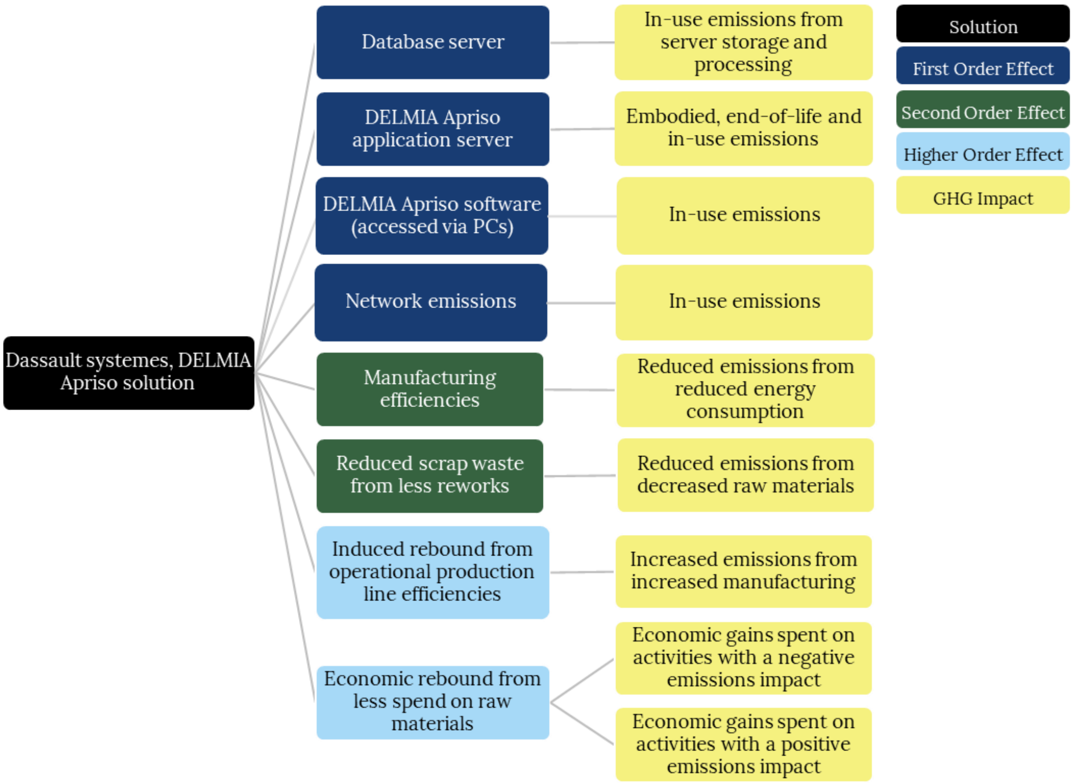

Identify First Order Effects

(A) All first order effects shall be identified that occur within the boundary of the ICT solution as defined in section 3.2.2 of the "Net Carbon Impact Assessment Methodology for ICT Solutions".

(B) The GHG impact of first order effects shall consider the full life cycle emissions of the ICT solution, that are not excluded by (C). This includes upstream emissions relating to solution's manufacture and transportation (embodied emissions), life cycle emissions from use and maintenance, and end of life treatment.

(C) Embodied and end-of-life emissions from ICT equipment or hardware that can be justified as already in existence without the solution implementation can be excluded from the calculation of first order effects with justification.

Dassault Systèmes, Operations management

Based on the results from the previous steps of identifying 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** (DELMIA Apriso Application Server)
    - 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 should be considered for the calculation of first order effects.
- **Network emissions**
    - 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.
- **Desktop (PC) emissions**
    - It is assumed that the **embodied (incl. transport) and end-of-life emissions of the PC devices** are already in existence even without the implementation of the solution in place, as they are unlikely to be purchased solely for this solution. These emissions are therefore excluded from the calculation of first order effects.
    - The marginal increase in **in-use desktop and laptop computer emissions** associated with the use of the DELMIA software are not part of the reference scenario and therefore should be considered for the calculation of first order effects.
- **Data centre processing and storage emissions (Database server)**
    - 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.
- **Software in-use emissions**
    - The **in-use software emissions** from operating systems (Microsoft Windows Server) and database engines (SQL Server or Oracle environments) associated with the ICT solution 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.

Identify Second & Higher Order Effects

(A) All second order effects shall be identified.

(B) All higher order effects shall be identified.

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Based on the results from the previous steps of identifying effects, the following second and higher order effects were identified:

Second order effects:

- A reduction in energy consumption from improved resource management by synchronising planning with production that increases operation and production line efficiencies.
- A reduction in scrap waste from the improved defect reporting which allows users to report visual quality defects from 3D models with greater accuracy. Detecting defects earlier on in the production process allows for reduced scrap waste and decreased emissions associated with reworking products.

Higher order effects:

- Potential rebound effect of increased efficiency of manufacturing operations, in the medium to long term, could lead to greater production capacity for the factories. If annual production was to increase this would increase annual emissions overall.
- The optimisation of defect reporting along the train production line, and more efficient material management reduces scrap waste and may reduce company costs by decreasing the purchase of raw materials. These cost savings, in the medium to long term, could be spent on alternative activities that have a positive or negative GHG emissions impact, or economic rebound. The cost savings could also enable the growth of manufacturing operations, resulting in an increase in train production volume and therefore higher absolute GHG emissions.

Given the potential system-wide scope of higher order effects, it should be acknowledged that this is not necessarily an exhaustive list and other higher order effects may be identified.

Calculating Effects

Estimating the Relative Magnitude of Effects

(A) An estimation of the magnitude of effects included in the assessment should be carried out for all identified GHG impacts resulting from first, second, and higher order effects.

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First order effects:

Embodied (incl. transport), end-of-life and in-use emissions of hardware (DELMIA Apriso Application Server) – these emissions were estimated to be small. The calculations should still aim to include this effect but may rely on secondary or proxy data if necessary.

In-use **desktop and laptop computer emissions** associated with the use of the DELMIA software – these emissions are expected to be relatively small. The calculations should still aim to include this effect but may rely on secondary or proxy data if necessary.

Data centre processing and storage emissions and network emissions marginal increase in in-use emissions – the in-use emissions the data centre and network emissions are assumed to be relatively small, but are still significant, given the amount of data being transferred. The calculations should still aim to include this effect but may rely on secondary or proxy data if necessary.

Second order effects:

A reduction in energy consumption from improved resource management by synchronising planning with production that increases operations and production line efficiencies. This second order effect results in reduced emissions from energy savings. It is assumed the energy savings from production line efficiencies is likely to account for a significant part of the GHG savings from second order effects, and high data quality should therefore be a priority for this effect.

A reduction in scrap waste from the improved defect reporting which reduces the non-conformity rate and emissions associated with reworking products. Given the emissions intensity of the scrap waste, it is assumed the reduced emissions from decreased scrap are likely to account for a more significant part of the GHG savings from second order effects, and high data quality should therefore be a priority for this effect.

Higher order effects:

- Potential rebound effect of greater production could increase annual emissions overall. This direct higher order effect could have a significant impact as it could negate the impact of the second order effect in the medium to long term. It should therefore be assessed using high data quality. It is also likely that the same data as provided for the second order effect will demonstrate this higher order effect.
- The reduction in scrap waste may result in cost savings from purchasing less raw materials. The impact could be positive if the reduction in costs increases the expenditure of lower carbon activities, or it could increase emissions if the reverse was the case. Nonetheless, the potential direct and economic rebounds from optimised defect reporting are limited by

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the savings achieved but may be material if the savings are large enough to enable increased vehicle manufacturing.

The identified potential higher order effects are generally speculative, and evidence of their existence would take longer time periods to materialise than the first and second order effects. It is extremely difficult to assess the magnitude of these higher order effects as their impact is highly uncertain. Therefore, effort should be made to track these impacts and their drivers in order to understand if any rebound is experienced.

Data Collection

Identifying Key Activities for each Effect

(A) For all effects identified under section 3.3 of the "Net Carbon Impact Assessment Methodology for ICT Solutions", suitable activities and activity emission intensities should be identified that can be used to estimate the GHG impact of each effect.

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Effect	Description	Activities
First Order	Embodied (incl. transport), end-of-life and in-use emissions of hardware: DELMIA Apriso Application Server	• Number of devices per functional unit • Cradle to grave footprint of hardware devices • Material breakdown of hardware devices (type and weight of material) • Likely disposal method of devices • Location of origin and destination, likely transport modes • Energy usage per device over lifetime • Power consumption of device and usage profiles

		• Electricity grid emission factor (GHG emissions per kWh) • Material emissions factors incl. end-of-life (GHG emissions per unit)
First Order	In-use network emissions	• Marginal energy consumption of network due to DELMIA Apriso • Electricity grid emission factor (GHG emissions per kWh)
First Order	In-use emissions from laptops used to operate the solution	• Marginal energy consumption of laptops due to operation of DELMIA Apriso software • Electricity grid emission factor (GHG emissions per kWh)
First Order	In-use emissions from data centre processing and storage	• Marginal energy consumption of data centres due to DELMIA Apriso • Electricity grid emission factor (GHG emissions per kWh)
Second order	A reduction in energy consumption from improved resource management by synchronising planning with production that increases operation and production line efficiencies.	• Energy consumption by type before and after the implementation of DELMIA Apriso solution. • Electricity grid emission factor (GHG emissions per kWh)

Second order effect	A reduction in scrap waste from the improved defect reporting which allows users to report visual quality defects from 3D models sooner and with greater accuracy.	• Scrap waste material composition and volume before and after the implementation of DELMIA Apriso solution. • Percentage of product reworks before and after the implementation of DELMIA Apriso solution. • Material emissions factors incl. end-of-life (GHG emissions per unit)
Higher order	Potential rebound effect of increased efficiency of manufacturing operations.	• Energy consumption in production factory before and after the implementation of DELMIA Apriso, several years after implementation. • Amount of vehicles manufactured annually before and after the implementation of DELMIA Apriso, several years after implementation.
Higher order	Potential economic rebound from the optimisation of defect reporting along the train production line which reduces scrap waste and may reduce company costs by decreasing the purchase of raw materials.	• Vehicles delivered before and several years after implementation of DELMIA Apriso. • Cost of manufacturing the vehicles before and several years after implementing DELMIA Apriso. • Likely spending habits of organisation before and several years after

		implementing DELMIA Apriso.

Data Quality and Availability Assessment

(A) A data availability and quality assessment should be carried out for all activities and activity emission intensities identified for each effect included in the assessment. The assessment shall be used to select the most appropriate data sources for the assessment.

(B) The data availability and quality assessment can then be used to select relevant data sources for the net carbon impact assessment by considering the following:

(i) The data quality and availability for each activity under both the reference and ICT solution scenario.

(ii) The ITU L1410 guidance for data quality and data quality review guidance.

(iii) The relative magnitude of the effect.

(C) All data sources and assumptions used when selecting applicable data should be documented and reported.

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Effect	Activities	Data for activity available?	Data quality
Embodied (incl. transport), end-of-life and in-use emissions of hardware: DELMIA Apriso Application Server	• Number of devices per functional unit • Cradle to grave footprint of hardware devices • Material breakdown of hardware devices (type and weight of material)	• Data available on DELMIA's Scope 1 & 2 emissions from CDP • DELMIA Scope 3 emissions include capital goods emissions and the solution's hardware, available on CDP • Attribution factors available	• Good –DELMIA scope 1,2 & 3 emissions from CDP • Fair – attribution factors are assumptions • Good – publicly available and reliable sources for electricity emission

	• Likely disposal method of devices • Location of origin and destination, likely transport modes • Energy usage per device over lifetime • Power consumption of device and usage profiles • Electricity grid emission factor (GHG emissions per kWh) • Material emissions factors incl. end-of-life (GHG emissions per unit)	from an external I Care consultants as a hypothesis • Yes – secondary sources for electricity grid emission factor • Yes – secondary sources available for material emission factors	factors and manufacturer specific energy mix also available • Good - publicly available and reliable sources for material emission factors
In-use network emissions	• Marginal energy consumption of network due to DELMIA Apriso • Electricity grid emission factor (GHG emissions per kWh)	• Data available on DELMIA's Scope 1 & 2 emissions from CDP which capture solution energy use • Attribution factors available from an external I Care consultants as a hypothesis • Yes – secondary sources for	• Good - DELMIA scope 1 & 2 emissions from CDP • Fair – attribution factor based on an evidenced assumption • Good – publicly available and reliable sources for electricity emission

		electricity grid emission factor	factors (EEA, 2020)
In-use emissions from laptops used to operate the solution	• Marginal energy consumption of laptops due to operation of DELMIA Apriso software • Electricity grid emission factor (GHG emissions per kWh)	• Data available on DELMIA's Scope 1 & 2 emissions from CDP which capture software energy use • No primary data on manufacturer scope 3 emissions • Attribution factor for software use available from an external I Care consultants as a hypothesis • Yes – secondary sources for electricity grid emission factor	• Good DELMIA scope 1 & 2 emissions from CDP • Poor – proxy used for manufacturer emissions • Fair – attribution factor based on a backed-up assumption • Good – publicly available and reliable sources for electricity emission factors (EEA) and manufacturer specific energy mix also available
In-use emissions from data centre processing and storage	• Marginal energy consumption of data centres due to DELMIA Apriso • Electricity grid emission factor (GHG emissions per kWh)	• Secondary data available on server power consumption • No data on number of manufacturer servers	• Poor – Assumed energy required to power four servers for seven hours a day over 5 days a week

		• Yes – manufacturer energy mix grid emission factor	• Good – publicly available and reliable sources for electricity emission factors (EEA, 2020)
A reduction in energy consumption from operation and production line efficiencies.	• Energy consumption by type before and after the implementation of DELMIA Apriso solution. • Electricity grid emission factor (GHG emissions per kWh)	• Yes, manufacturer annual energy consumed split by energy type before the solution implementation available. • The rate of non-conformity of machined products that require rework available to calculate energy consumption after the solution has been implemented. • Yes – secondary sources for electricity grid emission factor and manufacturer energy mix available	• Good – based on 1 year of data prior to solution implementation (2014) • Fair – rate of non-conformity based on the I Care – 3DS avoided emissions calculation tool due to the lack of first-hand data available from the manufacturer, including for confidentiality reasons, this rate is an indicative value estimated by the third-party consultants who supported 3DS in the construction of the avoided emissions

			calculation tool. • Good – publicly available and reliable sources for electricity emission factors (EEA) and manufacturer specific energy mix also available
A reduction in scrap waste from the improved defect reporting.	• Scrap waste material composition and volume before and after the implementation of DELMIA Apriso solution. • Percentage of product reworks before and after the implementation of DELMIA Apriso solution. • Material emissions factors incl. end-of-life (GHG emissions per unit)	• Yes, primary data on train material composition, split by material type • Secondary data on train dimensions to calculate volume of material • Primary data on rates of non-conformity of machined products that require rework before and after provided by DELMIA 3DS Apriso engineers • Yes – secondary sources available for material emission factors	• Overall data quality rated Good to Fair due to the provision of primary data • Good - publicly available and reliable sources for material emission factors (Base Carbon ADME)

Potential rebound effect of increased efficiency of manufacturing operations.	• Energy consumption in production factory before and after the implementation of DELMIA Apriso, several years after implementation. • Amount of vehicles produced annually before and after the implementation of DELMIA Apriso, several years after implementation.	• No data/information on manufacturing volume available over time.	• Not applicable
Economic rebound from the optimisation of defect reporting along the train production line reduces scrap.	• Vehicles delivered before and several years after implementation of DELMIA Apriso. • Cost of manufacturing the vehicles before and several years after implementing DELMIA Apriso. • Likely spending habits of organisation before and several years after implementing DELMIA Apriso.	• No data/information on spending habits available and information would be difficult to obtain.	• Not applicable

First Order Effects

(A) The GHG impact of all first order effects shall be calculated for each implementation context within the boundary conditions except for those excluded by the cut-off criteria.

(D) First order effects shall be calculated for all life cycle phases of the solution.

(i) Embodied and end-of-life emissions shall be allocated equally across the lifetime of the solution and included according to the time period of the assessment

(ii) Use-phase emissions shall be calculated for the time period of the assessment.

(E) First order effects shall be calculated in relation to the functional unit and for the level of activity defined by the functional unit performance. If the functional unit requires multiple units of the solution or its components for the level of activity, as many units as required will be calculated.

(F) A conservative approach should be applied for all calculations of first order effects, i.e. emissions should rather be overstated than understated.

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The first order effects consist of the emissions associated with production of the solution software and hardware as well as emissions associated with manufacturer's use of software and associated hardware.

Emissions generated from the development of the Delmia Apriso software are estimated by calculating Delmia 3DS's Scope 3 capital goods emissions attributed to the purchase of hardware used in software development (desktops, laptop computers and servers) and attribution of Delmia 3DS's Scope 1 & 2 emissions to capture the additional energy use for the software development.

Emissions associated with the solution components and the manufacturer's use of the Delmia 3DS solution are estimated by calculating the attribution of the manufacturer's Scope 3 capital goods (desktops, laptop computers and servers) emissions associated with the use of the DELMIA software attribution of the manufacturer's Scope 1 & 2 for energy use relevant to running the DELMIA software.

Solution emissions – development:

These are calculated as an attribution factor of Delmia 3D's Scope 1 & 2 emissions for energy use and Scope 3 capital goods emissions for hardware. Attribution factor of 1% was determined by Dassault and team of experts as the proportion of Delmia 3DS's revenue earned for this project over 3DS's overall revenue over the life of the project.

Solution emissions – use:

In the I Care – 3DS Avoided emissions calculation tool, these are calculated as an attribution factor of 0.01% of the Manufacturer's Scope 1 & 2 emissions allocated for energy consumed and 1% of Scope 3 Capital goods emissions for associated hardware use. Attribution factors were determined by external I Care consultants as a hypothesis.

The EGDC calculation tool estimates these as the emissions associated with the energy required to power four servers for seven hours a day over 5 days a week. As no further information was accessible, this is an estimation of the actual number of servers in place however the calculation tool offers the possibility to adjust this variable.

(B) Cut-off criteria for first order effects:

(i) Solution components common between the reference and solution scenarios where the GHG impact has not been modified.

(ii) Where data availability prevents calculation of the GHG impact, first order effects may be excluded from the net carbon impact assessment if they can be demonstrated to be less than 5% of the total net carbon impact or net carbon impact per functional unit.

(iii) If multiple first order effects are considered for cut-off, the total effect must remain less than the 5% threshold.

(C) Exclusions of any first order effects from net carbon impact assessments shall be supported by clear justification and supporting calculation.

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Attribution of capital goods Scope 3 emissions should be based on the Scope 3 capital goods for the year the specific hardware used was purchased. For the present case study, emissions for all scopes were provided from the 2019 CDP report. Due to the low level of materiality of these emissions, the lack of further data and to provide an order of magnitude of emissions, the 2019 data was included. A full product carbon footprint should also consider emissions linked to the delivery of the hardware to Dassault. Due to the immateriality of these emissions in the current study, these have not been captured in the assessment, however this is a point to consider for completeness of approach.

Second Order Effects

(A) The GHG impact of all identified second order effects (positive and negative changes to the reference scenario) shall be calculated for the same implementation context except for those excluded by the cut-off criteria.

(C) The GHG impact of second order effects shall be calculated with a life cycle perspective.

(D) The second order effect calculation shall exclude additional rebound usages in the quantification of the GHG impact.

(E) The second order effect calculation shall exclude existing occurrence of the second order effect from other similar ICT solutions.

(F) Second order effects shall be calculated in relation to the functional unit and for the level of activity defined by the functional unit performance.

(G) If a net carbon impact assessment is to be used for public claims of a solutions' impact (including annual reporting) primary data should be used for either the reference or ICT solution scenario, or both.

(H) A conservative approach should be applied for all calculations of second order effects i.e. net positive emissions should rather be understated than overstated.

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The avoided emissions from reduced scrap waste are calculated by estimating the carbon emissions associated with the mix of materials used in a vehicle.

The avoided emissions from reduced energy consumption are calculated by applying the weighted average carbon intensity of the difference in manufacturer energy use between the reference scenario and the 3DS scenario. The weighted average carbon intensity of energy use is estimated by applying different energy source emission factors in proportion to the manufacturer's energy mix percentages.

It is assumed that the use of the DELMIA Apriso solution makes it possible to reduce the scrap rate by 2%, from 7% to 5%. This rate was applied from the I Care – 3DS avoided emissions calculation tool as the rate of non-conformity of machined products that require rework. Due to the lack of first-hand data available from the manufacturer, including for confidentiality reasons, this rate is an indicative value estimated by the consultants who supported 3DS in the construction of the avoided emissions calculation tool. The DELMIA Operations Engineering (Digital Manufacturing) results in less mistakes when producing train parts from raw material such as aluminium. This results in less material waste being realized, because the manufacturing process is optimised partially through the virtual twin. The assumption made is that the use of DELMIA makes it possible to reduce the scrap rate from 7% to 4% (optimistic scenario) vs 5% (conservative scenario).

Energy consumed in the 3DS scenario is estimated by applying a multiplier that is the rate of non-conformity of machined products that require rework in the 3DS scenario over that same rate in the BAU scenario. This assumes that the change in energy use between the two scenarios is proportional to the change in the amount of work carried out on the machined products. For increased accuracy and best practice, actual energy usage should be measured. Due to the indicative nature of the rate of rework, the proportional energy efficiency is the same across vehicles.

Assumptions were made on the percentage of material mix of the vehicles based on available industry literature for specific vehicle series, on the percentage empty space of the vehicles based on volume calculations from vehicle specification sheets, and the TGV (train example) dimensions and material mix were from the initial TGV manufacturing case. For the material recycling rates, European average recycling rates are used to align with the 'I Care – 3DS Avoided emissions calculation tool'.

(B) Cut-off criteria for second order effects:

(i) GHG impacts from identified second order effects may be excluded from the net carbon impact assessment if they can be demonstrated to be less than 5% of the total net carbon impact or net carbon impact per functional unit. Positive second order effects of any magnitude may also be excluded (typically due to data availability).

(ii) If multiple second order effects are considered for cut-off, the total effect must remain less than the 5% threshold.

(iii) Cut-offs of any second order effects from net carbon impact assessments shall be supported by clear justification and supporting calculation.

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The reduction in fuel consumption from decreased transport between sites, is a positive second order effects that was excluded from the calculation because it is outside of the calculation boundary.

Higher Order Effects

(A) A qualitative assessment shall be undertaken for all identified higher order effects, including how and where they would occur, within what timeframe, the expected magnitude, and the likelihood of the effect occurring. The strength of the relationship between the solution and the higher order effect should be considered and ideally be demonstrated by academic research.

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Qualitative assessment of identified higher order effects:

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Higher order effects	How and where they would occur	Timeframe	Expected magnitude	Likelihood of effect occurring	Causal relationship to solution?
Production rebound from increased efficiency of manufacturing operations	Greater production capacity at the factories could increase annual emissions through increased train production.	Long term	Medium	Low	Yes
Economic rebound from reduced purchase of raw materials	More efficient resource management reduces scrap waste and can lead to cost savings from the reduced purchase of raw materials. The cost savings could be spent on alternative activities that have a positive or negative GHG emissions impact.	Medium-long term	Low	Medium	No

(B) Where a quantitative assessment is possible, the GHG impact of all identified higher order effects (positive and negative) should be calculated for each implementation context within the boundary conditions.

(i) Significant effects shall not be excluded from quantitative assessment if robust data and knowledge of the effect exist.

(ii) Effects deemed significant but not quantifiable shall be supported by clear justification and reported alongside the net carbon impact quantitative results.

(iii) Effort should be made to collect necessary data or carry out necessary studies with the intention of quantitatively assessing the effect in the future and the exclusion shall be re-evaluated during the recalculation assessment**Error! Reference source not found.**.

(C) The GHG impact of higher order effects shall be calculated with a life cycle perspective, where it is feasible.

(D) Higher order effects shall be calculated in relation to the functional unit and for the level of activity defined by the functional unit performance.

(E) A conservative approach should be applied for all calculations of higher order effects, i.e. net positive emissions should rather be understated than overstated

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No identified higher order effects were included in the calculation.

Manufacturing rebound: Due to the lack of data on the production capacity after the implementation of the solution, this higher order effect was not included in the assessment.

Economic rebound: Due to the lack of data and difficulty in establish a causal link this higher order effect was not included in the assessment.

Net Carbon Impact Calculation

(A) The total net carbon impact of the solution shall be calculated including all quantified first, second, and higher order effects included in the assessment, for the time boundary of the assessment.

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Total carbon savings enabled for the train use case in the case of 25 vehicles produced

Total annual net carbon savings impact: 5,175 tCO2e/year

1st order effect: 94.8 tCO2e/year

2nd order effect: 5,269 tCO2e/year

Annual carbon savings per functional unit: 207 tCO2e/ vehicle produced

(B) Significant changes to the calculated GHG impacts of first, second, or higher order effects during the time period of the assessment shall be included in the assessment.

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Any changes during the time period of the assessment, such as changes in emission factors, have been considered in the calculation.

Uncertainty and sensitivity analysis

(A) A sensitivity analysis should be carried out for all key parameters as part of the net carbon impact assessment.

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The sensitivity analysis shows the impact of varying the inputs to the net impact calculation in different implementation contexts. The sensitivity of second order emissions is relatively low, on average +/-0.44%, to variations in average masses of materials, their associated emissions factors, and the solution's energy consumption. The activity data on the energy consumption of the reference scenario and the DELMIA 3DS scenario are the most sensitive inputs. When the activity data for the reference scenario energy consumption is varied by -5%, the net carbon impact decreases to 2,344 tCO2e. Alternatively when the activity data is varied by +5%, the net carbon impact increases to 8,005 tCO2e. The percentage change of the solution's net carbon impact when varying this parameter is −54.69 % and 54.69% respectively. Overall, the solution's annual carbon savings impact figure of 5,175 tCO2e has a sensitivity of +/- 2,830 tCO2e, when assessing different implementation contexts with varying activity data.

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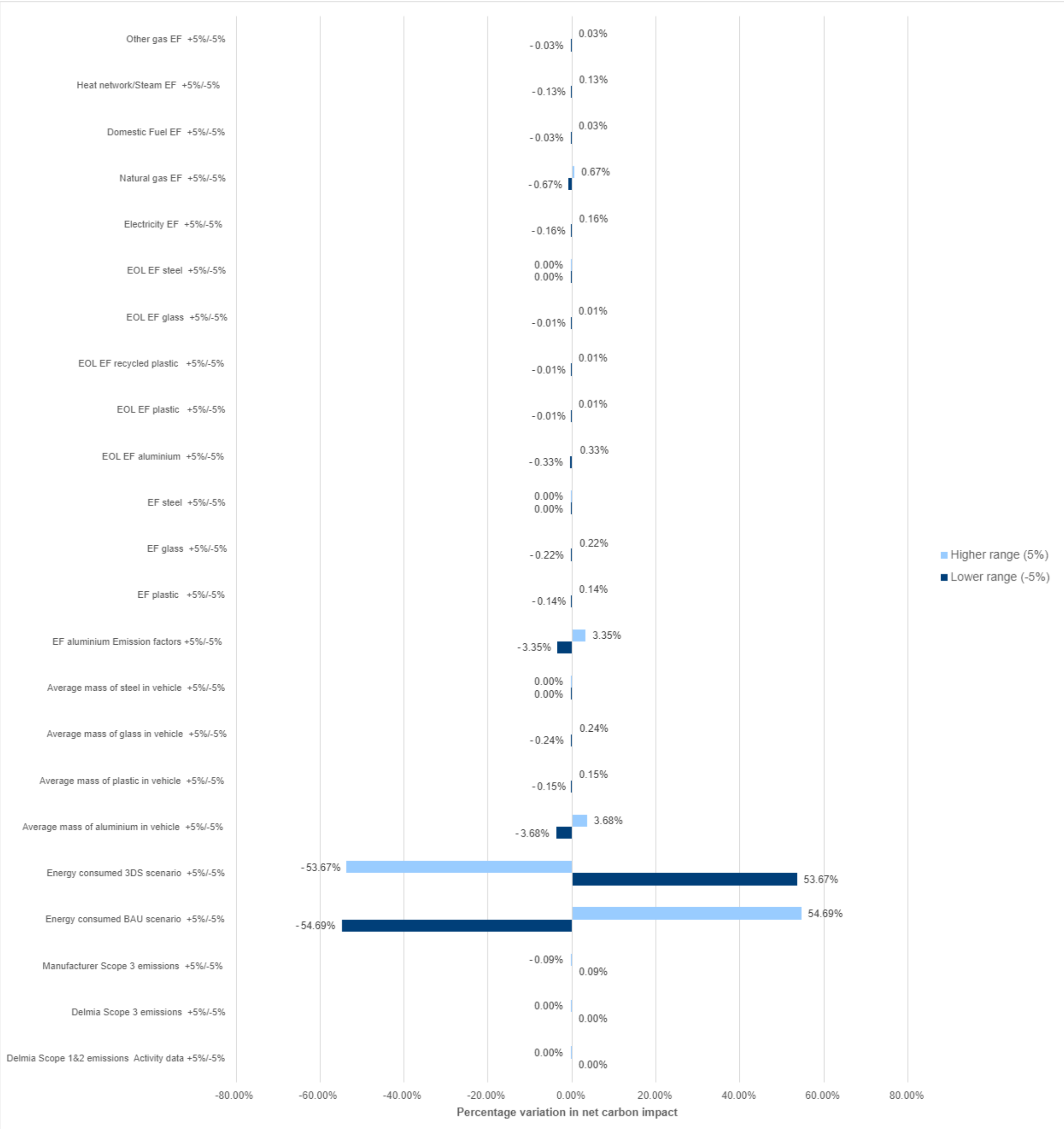

(B) A net carbon impact assessment should include an uncertainty analysis of the results.

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The overall data quality for first order emissions is fair, with relatively precise energy consumption data. The data is assessed as poor where large assumptions have been made due to the solution developer's lack of access to manufacturer data due to information sensitivity. Efforts should be made to improve the activity data on the manufacturer's server emissions, manufacturer's scope 3 emissions and the server energy use to make it specific to the activity.

			Qualitative Assessment of Data Quality				
Data type	Impact effect	Description of effect	Activity	Time	Geography	Reliability	Completeness
Activity Data	1st order	Delmia Scope 1&2 emissions	Good	Fair	Fair	Fair	Fair
	1st order	Delmia Scope 3 emissions	Good	Fair	Fair	Fair	Fair
	2nd order	Manufacturer Scope 3 emissions	Fair	Good	Poor	Fair	Fair
	2nd order	Manufacturer servers	Poor	Poor	Poor	Poor	Poor
	2nd order	Server energy use	Poor	Poor	Poor	Poor	Poor
	2nd order	Average % of empty space in a vehicle	Fair	Fair	Fair	Fair	Fair
	2nd order	Average length of a vehicle	Good	Good	Good	Good	Good
	2nd order	Average width of a vehicle	Good	Good	Good	Good	Good
	2nd order	Average height of a vehicle	Good	Good	Good	Good	Good
	2nd order	Average proportion of vehicle materials that is aluminium	Fair	Good	Good	Good	Fair
	2nd order	Average proportion of vehicle materials that is plastic	Fair	Good	Good	Good	Fair
	2nd order	Average proportion of vehicle materials that is glass	Fair	Good	Good	Good	Fair
	2nd order	Average proportion of vehicle materials that is steel	Fair	Good	Good	Good	Fair
	2nd order	Density of aluminium	Good	Good	Good	Good	Good
	2nd order	Density of plastics	Good	Good	Good	Good	Good
	2nd order	Density of glass	Good	Good	Good	Good	Good
	2nd order	Density of steel	Good	Good	Good	Good	Good
	2nd order	% of aluminium that is recycled	Good	Fair	Good	Good	Fair
	2nd order	% of plastics that is recycled	Good	Fair	Good	Good	Fair
	2nd order	% of glass that is recycled	Good	Fair	Good	Good	Fair
	2nd order	% of steel that is recycled	Good	Fair	Good	Good	Fair
	2nd order	Average volume of aluminium in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Average volume of plastic in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Average volume of glass in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Average volume of steel in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Average mass of aluminium in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Average mass of plastic in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Average mass of glass in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Average mass of steel in vehicle	Fair	Good	Good	Good	Fair
	2nd order	Energy consumed BAU scenario	Good	Good	Good	Good	Good
	2nd order	Energy consumed 3DS scenario	Fair	Good	Fair	Poor	Fair
Emission factors	2nd order	EF aluminium	Good	Good	Good	Good	Good
	2nd order	EF plastic	Good	Good	Good	Good	Good
	2nd order	EF glass	Good	Good	Good	Good	Good
	2nd order	EF steel	Good	Good	Good	Good	Good
	2nd order	EOL EF aluminium	Good	Fair	Good	Good	Fair
	2nd order	EOL EF plastic	Good	Fair	Good	Good	Fair
	2nd order	EOL EF glass	Good	Fair	Good	Good	Fair
	2nd order	EOL EF steel	Good	Fair	Good	Good	Fair
	1st order	Electricity EF	Good	Fair	Good	Good	Good
	1st order	Natural gas EF	Good	Fair	Good	Good	Good
	1st order	Domestic Fuel EF	Good	Fair	Good	Good	Good
	1st order	Heat network/Steam EF	Good	Fair	Good	Good	Good
	1st order	Other gas EF	Good	Fair	Good	Good	Good

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

Recalculation

(A) It may be suitable that an assessment calculated for one year can be repeated in following years without changes, however, the reference scenario, implementation context, assumptions, exclusions, methods, and data used shall be reviewed annually to be applicable before continuing to use the results of an assessment.

(B) If the review identifies necessary changes to the assessment that could change the results by more than 5%, recalculation in whole or part will be necessary.

(C) Recalculation of the assessment should take place at a maximum of three years after the original assessment to ensure its validity.

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The assessment should be reviewed annually to ensure its validity as it is based off several assumptions and data whose quality was assessed as generally fair which contributes to the calculations' uncertainty. If higher quality data becomes available, especially around the 1st order effects and 2nd order effects such as the database and DELMIA servers' energy use, data inputs should be adjusted to improve the accuracy and validity of the assessment.

Other considerations for a net carbon impact assessment

Do No Significant Harm

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The solution is not expected to cause significant harm in other ESG areas.

The six environmental objectives as defined by the EU Taxonomy are as follows:

1. Climate change mitigation
2. Climate change adaptation
3. Sustainable use and protection of water and marine resources
4. Transition to a circular economy
5. Pollution prevention and control
6. Protection and restoration of biodiversity and ecosystems

The DELMIA Apriso solution contributes to objectives 1, 4 and 5 by reducing manufacturer emissions through energy and scrap waste savings and does not harm objectives 2 (does not hinder climate change adaptation), 3 (does not negatively impact the use of water or marine resources) or 6 (application in existing manufacturing environments, therefore no implied negative impact to biodiversity and ecosystems).

Using Results in Other Implementation Contexts

(A) The new implementation context shall have the same ICT solution scenario and reference scenario as the original net carbon impact assessment.

(B) The parameters of the original net carbon impact assessment should be adjusted to reflect the new implementation context.

(C) Where it is not possible to adjust the assessment parameters, the results should only be used in other implementation contexts if a review determines that the changes are not expected to significantly change the results or overestimate a positive impact.

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- **Manufacturer reference scenario energy consumption and manufacturing processes**: Direct measurement of the manufacturer's energy use, segregated to the relevant production process included in the assessment should be continuously captured over the years of implementation to provide sufficient granularity. Any changes in the factory environment should be taken note of in order to robustly attribute any variations in energy use to the solution.
- **Country Selection**: Emission factors must be adjusted to reflect the electricity sources in the manufacturer's energy mix.
- **Vehicle types**: The assessment focuses on the implementation of the DELMIA Apriso solution in a train manufacturer. If a different vehicle type is to be assessed, the vehicle material mix and vehicle dimensions must be adjusted.
- **Manufacturer annual output**: The assessment is on a train manufacturer that produces 25 trains a year. The vehicles produced annually must be adjusted if the implementation context differs to capture the appropriate manufacturing non-conformity rates.
- **Business as usual scrap rate**: If a manufacturer has a varying scrap /non-conformity rate this must be adjusted to calculate the reference scenario emissions coming from waste along the production line.
- **Manufacturer energy mix**: The manufacturer energy mix must be adjusted to capture the manufacturing energy consumption accurately based on the energy sources used.
- **Materials recycling rates**: If new materials are procured to manufacture the vehicles, their recycling rates must be adjusted to capture the raw materials' full lifecycle emissions.
- **Type of trains manufactured**: The composition of vehicle types can change. The materials being used could impact the emissions related to the production of the trains and therefore the reference and enabled scenario emissions could change and impact the solution's net carbon impact.
- **Solution efficiencies**: Improvements in the solution hardware and software, particularly around energy efficiencies, could result in decreased energy consumption. This could lower and reduce the first order effect emissions, and overall net carbon impact of the solution.

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Communicating and Documenting Outcomes of a Net Carbon Impact Assessment

Communicating and documenting outcomes of a single ICT solution

Organisations communicating results from a net carbon impact assessment of a single ICT solution should disclose:

(A) The total net carbon impact, as well as a breakdown by first order, second order, and higher order effects included in the quantitative assessment.

(B) The qualitative assessment of all higher order effects deemed to be likely and/or of significant magnitude and any actions undertaken to mitigate the effect.

(C) Any other environmental impacts identified from the do no significant harm assessment and any actions undertaken to mitigate their effect.

(D) A description of the ICT solution and assessment including the reference scenario, assessment perspective (actual/potential), implementation context(s), and time period.

(E) The organisation's contribution to the ICT solution and limitations to the calculation.

Organisations communicating results from a net carbon impact assessment of a single ICT solution are encouraged to disclose or provide on request:

(F) Documentation for the assessment including the boundary, calculation methodology, rationales (e.g. justification of reference scenario), assumptions, data sources and uncertainty of the results.

(G) A relative metric for the net carbon impact in relation to the business operations, e.g. percentage of total revenue associated with the solution.

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The results of the assessment have been documented in a combined methodology document, which can be found here.

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