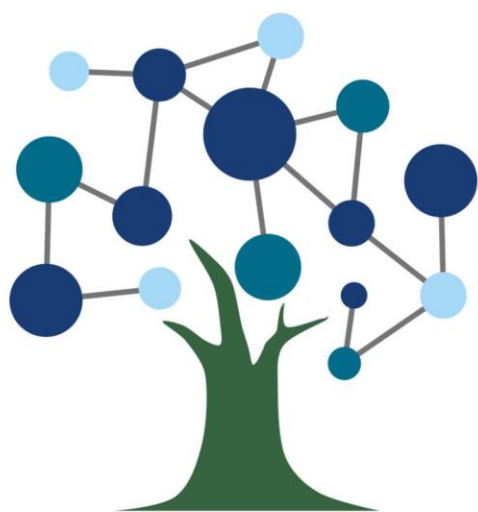




# Net Carbon Impact Assessment Methodology for ICT Solutions

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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.

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**Deliverable 5.5. –  
Net Carbon Impact Assessment Methodology for ICT  
Solutions**

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## 1. Introduction

### 1.1. Introduction

Society is undergoing both green and digital transitions<sup>1</sup>. The digital transition can support and amplify the green transition, and we are seeing examples such as the increased use of AI optimising the use of resources and distributed ledger technologies enabling the circular economy. However, without due consideration, the digital transition can oppose the green transition in ways such as increased electricity demand, natural resource use, or waste. The challenge facing the ICT sector at the centre of the digital transition is to ensure it minimises these harmful effects, while at the same time maximising the potential role it can play in supporting the transition to a Net Zero future.

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<sup>2</sup>. 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<sup>3</sup>:

- 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, and
- 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. It is also acknowledged that the ICT sector can induce additional emissions in other sectors and these effects should be mitigated.

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<sup>1</sup> Joint Research Centre, E. C., 2022. [The twin green & digital transition: How sustainable digital technologies could enable a carbon-neutral EU by 2050.](#)

<sup>2</sup> Council of the EU, 2020. [Digitalisation for the benefit of the environment: Council approves conclusions.](#)

<sup>3</sup> European Green Digital Coalition, 2022. [The Declaration.](#)



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 assessed in a robust and consistent way. Responding to this need and following from the EGDC Declaration, this document provides a methodology for the ICT sector to develop methods and tools to measure the net impact of ICT solutions on the climate.

The methodology was created as part of the EGDC EU Parliament pilot project that has been established to support the Coalition with achieving its commitments.

## 1.2. What is a Net Carbon Impact Assessment?

The net carbon impact of a solution is the comparison between the carbon impacts of a scenario with an ICT solution and a reference scenario without the ICT solution within the same boundary. The total positive and negative carbon impacts of each scenario are considered including all direct and indirect effects within the boundary of the assessment. This methodology is limited to quantitatively considering the impact from greenhouse gas emissions, calculated in CO<sub>2</sub>e. Therefore, it has been termed a net carbon impact assessment where the outcome can be positive or negative and using carbon to refer to GHG emissions generally. Due to the challenges with quantifying some indirect effects (higher order effects – see section 2.3.3), these may only be assessed qualitatively in the assessment.

While the data used within the assessment can be based on an actual scenario, a net carbon impact assessment is a hypothetical assessment as either the reference scenario or the ICT solution scenario is counterfactual as they cannot both occur at the same time. The assessment is agnostic to the outcome, either an addition or an avoidance of emissions, as it considers both positive and negative effects resulting from the implementation.

Other terminologies which refer to the same concept are avoided emissions, carbon abatement, and enablement. These meanings can differ depending on the context in which they are used and so are not always directly comparable. These terms also all predispose a positive outcome and are therefore not as suitable for the purpose of this methodology. ITU use terminology of “net second order effects” which is discussed in section 2.3.

## 1.3. Methodology Aim and Purpose

The aim of this document is to provide a method to assess the net carbon impact on climate change of ICT solutions and identify those that can deliver a net positive impact by reducing emissions outside of the ICT sector. This aim is driven by three main purposes:



1. Supporting the assessment of data-driven ICT solutions for GHG emission reductions as outlined by the EU Taxonomy<sup>4</sup> substantial contribution criteria detailed in Activity 8.2 of the supplementary Annex 1<sup>5</sup>.
2. Supporting organisations in the calculation of the EGDC KPIs<sup>6</sup> to monitor investment in the development and deployment of ICT solutions with significant energy and material efficiency that achieve a positive net impact (see Appendix 7: EGDC KPIs).
3. Support transitioning the economy towards net zero and reducing total carbon emissions by providing a consistent approach to assessing the net impact of ICT solutions to help facilitate private and public adoption of ICT solutions.

This methodology aims to support these purposes by answering the following questions addressed in the respective sections of the methodology:

- How should the net carbon impact of an ICT solution be assessed, both in a specific implementation context and in multiple contexts? How should the assessment differ between already realised vs. future potential impacts? (Sections 3 and 4)
- How should the net carbon impact of a single ICT solution and associated claims be communicated or reported on? (Section 5)

Following the methodology a section is provided to support organisations communicating their contribution by answering the following questions:

- Who can claim to have contributed to the net carbon impact of an ICT solution and how much can be claimed by each contributor?
- How can the impact of several ICT solutions be aggregated?

The methodology aims to provide a practical, hands-on guide that addresses these questions and provides consistency in how they should be answered by building upon existing standards, predominantly ITU-T L.1480, Mission Innovation: The Avoided Emissions Framework, and WBCSD Guidance on Avoided Emissions. Recognising the challenges around data collection and availability the methodology allows for different levels of maturity of data and approaches, but users of the methodology should aim to improve the quality of their data and approach over time. If some of the challenges are

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<sup>4</sup> [Regulation \(EU\) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation \(EU\) 2019/2088](#)

<sup>5</sup> [Annex 1 supplementing Regulation \(EU\) 2020/852 of the European Parliament and of the Council](#)

<sup>6</sup> The EGDC KPIs and guidance on how to report against these KPIs can be found in Appendix 7.



addressed through these improvements, it is possible that the requirements and criteria outlined in this methodology are updated at a later stage.

The intended users of this standard are analysts involved in the development, deployment, and use of ICT solutions who want to assess the impact of an ICT solution. Furthermore, this methodology can be used by other sectors to ICT that are adopting ICT solutions in order to assess the net carbon impact of ICT solutions in these sectors. The outcomes of these assessments will aid decision-makers in organisations, the investment community, and government bodies driving and financing the development and deployment of ICT solutions. More specific guidance around the implementation of ICT solutions in specific sectors can be found in the EGDC Sector Methodologies<sup>7</sup> for agriculture, buildings and construction, manufacturing, power, smart cities, and transport.

Net carbon impact assessments should assess the full ICT solution that delivers a specific service to the user. The methodology should not be used to assess the impact of part of a solution (e.g. one component) that by itself cannot deliver the service. For example, the methodology should not be used to assess the net carbon impact that cloud computing can have as a solution component, as the full extent of all the solutions it is used in, and its implementations, are unknown and cannot be accounted for. For further guidance see section 2.1. The contribution of different actors involved with the solution (e.g. solution component provider) is discussed in section Claiming Net Carbon Impacts as an Organisation.

While the focus of the methodology is to assess the carbon impact of solutions, ICT organisations should also demonstrate the solutions they produce do no significant harm to other environmental indicators as required by the EU Taxonomy (section 3.9.1).

## 1.4. Relationship to Existing Standards

### **ITU-T L.1480 - Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors (12/2022)**

The methodology is interoperable with the International Telecommunication Union (ITU) standard ITU-T L.1480 (12/2022) recommendation and provides practical guidance and supplementing principles for assessors to apply the recommendation. ITU-T L.1480 defines tiers of assessment which allow for different depths of assessment. The outcome of an assessment following the EGDC methodology aligns to a Tier 1 assessment. Tier 2 and Tier 3 depths outlined by the ITU are less in-depth than Tier 1. For a full review of the alignment

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<sup>7</sup> The EGDC Sector methodologies will be published alongside this methodology and can soon be found on the EGDC website

of ITU-T L.1480 and this methodology please refer to Appendix 4: Alignment to ITU-T L.1480.

## **Guidance on Avoided Emissions: Helping business drive innovations and scale solutions toward Net Zero. World Business Council for Sustainable Development (2023).**

The methodology is closely aligned with the WBCSD guidance despite the guidance not being aimed at the ICT sector and some ICT solutions being outside the scope of the guidance which does not address digital services<sup>8</sup>. The key areas of differentiation are:

- The EGDC Method is outcome-agnostic aiming to provide a method for assessing the net carbon impact of ICT solutions (both positive and negative). WBCSD Guidance focuses on avoided emissions (positive carbon impact).
- The EGDC Method focuses more narrowly on the assessment of the net carbon impact of ICT solutions, while the WBCSD Guidance has a boarder focus on the companies developing and reporting the results from the assessments, and therefore includes safeguards such as the eligibility gates.

For a full review of the alignment of WBCSD Guidance on Avoided Emissions and this methodology please refer to Appendix 5: Alignment to WBCSD Guidance on Avoided Emissions.

## **Other standards and reference materials**

Several other standards and reference materials have been reviewed in the development of this methodology. These are listed in Appendix 3: Reference Materials.

## **1.5. Methodology Structure**

To achieve the purposes of the methodology and address the questions outlined above the methodology is structured in different sections. The structure first establishes the concepts used throughout the methodology, then guides assessors through the necessary assessment steps, before outlining how to communicate the results from the assessment.

Section 2	<b>Concepts</b> – this section provides an overview of the main concepts used throughout the methodology
Section 3	<b>Assessing the net carbon impact of an ICT solution in a specific implementation context</b> – this section focuses on assessing the impact of an ICT solution in a specific implementation context and

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<sup>8</sup> Section 1.4 of WBCSD Avoided Emissions Guidance – Scope of Guidance

considers both realised GHG impacts of a deployed solution (ex-post) and future potential impacts of a solution (ex-ante).

## Section 4

**Using results in other implementations contexts** – this section provides guidance on how and when the results from a net carbon impact assessment in a specific implementation context can be used to assess other implementation contexts.

## Section 5

**Communicating and documenting outcomes of a net carbon impact assessment** – this section defines how outcomes and claims should be communicated and documented for a single ICT solution.

## Claiming & Reporting Net Carbon Impacts as an Organisation

**Claiming Net Carbon Impacts as an Organisation** – this section provides guidance on how and when organisations providing ICT solutions and components should claim net carbon impacts of solutions where they are involved.

**Reporting Aggregated Impacts of Multiple Solutions** – this section defines how organisations should communicate and document the aggregated total impact of ICT solutions they are contributing towards.

## Appendices

### Abbreviations

### Glossary

**Reference Materials** – standards and reference materials reviewed during the development of this methodology.

**Alignment to ITU-T L.1480** – Analysis of differences in approach, terminology, and scope with the ITU-T L.1480 standard.

**Alignment to WBCSD Guidance** – Analysis of differences in approach, terminology, and scope with the WBCSD Avoided Emissions Guidance.

**Reference Scenario Selection** – Explanation of the decision process for the reference scenario definition.

**EGDC KPI's** – Key performance indicators defined by EGDC for reporting purposes.

**Example disclosure** – Example table for disclosure of a net carbon impact assessment.

## 1.6. Application of the Methodology and Future Ambition

A level of judgement and discretion may be required in the application of the methodology in recognition of the variability of ICT solutions and their implementations. When situations arise where the application of the methodology to a specific implementation is ambiguous the reporting principles established in the GHG Protocol accounting and reporting standards<sup>9</sup> should be applied, namely: relevance, accuracy, completeness, consistency, transparency, and conservativeness.

Accuracy of the assessment is a key principle which this methodology aims to achieve with consideration of existing constraints at the time of publication. The key constraints are organisation's ability to extensively collect primary data, the availability of high-quality secondary data relevant to specific solution implementations, and a lack of knowledge and data relating to higher order effects, such as rebound effects. Organisations should aim for continuous improvement of assessments in recognition that constraints for each organisation will be different and will change over time. If the current constraints improve significantly through further research and an increase in publicly available high-quality data, future versions of this methodology may update requirements to increase ambition.

This methodology only assesses GHG emissions quantitatively. Other environmental impacts are assessed according to do no significant harm criteria and social impacts of ICT solutions are not considered. To ensure that resources and finances are being directed effectively, it is important to take a holistic approach when assessing the impact of ICT solutions. This is especially important where ICT solutions may have net positive impacts in one area, but a negative impact in another. While the methodology requires a qualitative assessment of other environmental impacts, a potential area of improvement for the methodology could be to provide quantitative guidance for assessing the net impact of other environmental or social aspects from ICT solutions.

Double counting of net carbon impacts can occur under this methodology when there are multiple organisations involved in the provision of the ICT solution. This is in line with other existing standards and frameworks on the topic and reflects a similar approach adopted for Scope 3 reporting. However, the effect of double counting in this methodology is likely to lead to double/multiple counting of positive impacts along chain of actors with substantial contributions. Therefore, when regarding net carbon impact claims of the ICT sector using this methodology, the total impact from different organisations should not be considered a reflection of the total sector impact. Future methodologies should look to adopt allocation of avoided emissions across the value chain if advances in knowledge and data availability allow.

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<sup>9</sup>Greenhouse Gas Protocol: [Policy and Action Standard](#) (2014) and [The GHG Protocol for Project Accounting](#) (2005)



This methodology includes the assessment of indirect effects at the minimum qualitatively, and quantitatively where it is feasible to do so. Despite this, indirect effects can be difficult to assess even only qualitatively, and much more so quantitatively, in particular, subtle, and potentially very significant macroeconomic effects of ICT services (such as indirect and structural rebound effects). As such, we acknowledge that a full robust assessment of these effects could not fall within the scope of the EGDC methodology, and future development is necessary in this area.



## 2. Concepts

### 2.1. ICT Solution

An ICT solution is a system of different digital and non-digital components that are combined to deliver a specific service to the user. The system includes all components necessary to collect, process, transmit, and store data, and any elements necessary to control or affect the system in which it is implemented. Typically, systems can include sensors, hardware for data processing and controls, software, local communications equipment, telecommunications network infrastructure, data storage, remote data storage and processing (e.g. data centres and cloud computing), displays, user interfaces, actuators, and any supporting services necessary for operation of these components.

In this methodology, an ICT solution refers to a specific service that the system is used to deliver. If the system can be applied to deliver a different service, this is considered as a different solution. For example, a system that can monitor and control airflow could be used to control ventilation in a building for comfort, if it can also be used to manage air flow in an industrial process to ensure the correct air quantity is supplied, this would be considered a different solution as the service provided is different. Net carbon impact assessments should only be carried out on the full solution and not be limited to only a part of the solution or one component. This would result in the boundary of the assessment not fully capturing the impact of the full solution and would require assessment of all of the use-cases of the component, as it may be used in other solutions, which is outside of the scope of this methodology.

The aim of the assessment is not to compare different brands of solutions against each other, but to assess the impact of an ICT solution against a technological or methodical alternative that provides the same function.

**ITU-T L.1480 definition of an ICT solution:** A system encompassing ICT goods, ICT networks and/or ICT services that contributes to meeting a technical, societal or business challenge.

### 2.2. Assessment Concepts

#### 2.2.1. Reference Scenario

The reference scenario reflects the situation without the implementation of the ICT solution. It is comprised of reference activities that form the end-to-end process that deliver the same service to the user as the ICT solution which is defined by the functional unit (see section 2.2.3). One or more scenarios may be applicable and so consideration of multiple scenarios may be required, further guidance is provided in section 3.2.5. The

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terminology “baseline” or “baseline scenario” is often also used to refer to the reference scenario.

A reference scenario of an agricultural ICT solution might be the manual measurement of soil moisture where the reference activities are travel to the crop for measurement, operation of equipment to take measurements, and the return travel. The activities may have no GHG impact, or they may result in one or multiple GHG impacts.

## 2.2.2. ICT Solution Scenario

The ICT solution scenario is the scenario representing the situation with the ICT solution present. The solution will either modify the reference activities (e.g. reducing resource use) or replace them with alternate activities (e.g. substitution of travel). There may also be some reference activities that remain unaffected.

## 2.2.3. Functional Unit

The functional unit is the quantified performance of the system for use as a reference unit to describe the GHG impacts of the ICT solution. The functional unit establishes a common reference for the measurement of the quantity and quality of the service provided under both the reference and ICT solution scenarios allowing a consistent comparison between the two. This is particularly important when a solution substitutes the reference activities with alternate activities, such as a monitoring solution replacing travel for manual inspections, in which case the functional unit should be related to the maintenance service and not travel or remote monitoring activity.

## 2.2.4. Implementation Context

The reference and ICT solution scenarios have to consider the context in which the solution is implemented as the context should be common to both scenarios. Each implementation of the ICT solution will have a different context, these differences may be small or significant, and further guidance to calculate multiple contexts is provided in section 4. The implementation context will be described by a set of parameters that are constant between the reference and ICT solution scenarios and by other contextual factors that can be described but do not have a defined parameter.

While ITU-T L.1480 considers the contextual factors, it does not differentiate the implementation context from the reference and ICT solution scenarios and considers this as part of these scenarios. This methodology has decided to make this distinction to aid assessors in defining the reference and ICT solution scenarios through consideration of the services they provide separately to the context they operate in.



## An example to illustrate the scenarios and the implementation context

A new office building in Berlin with 8 floors of 2,000 square metres each is being constructed including a high functionality building management solution.

- Reference scenario: a low functionality BMS solution that controls the heating and lighting systems in the building.
- ICT solution scenario: a high functionality BMS solution has additional functionalities of IoT connectivity for improved control of the heating and lighting, and additional control of cooling in the building.
- Implementation context: the new office building in Berlin with 8 floors of 2,000 square metres each. Office open hours of 7am – 9pm and the external temperatures experienced during the time period. Other contextual factors include use attitudes towards internal temperature set point and financial incentives to reduce operational costs.

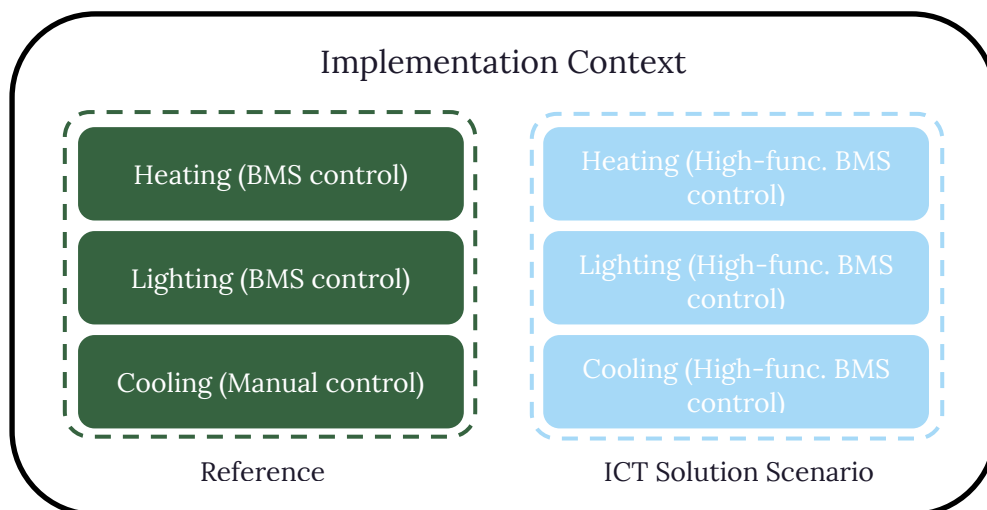


Figure 1: A building management system (BMS) example

## 2.3. Components of a Net Carbon Impact Assessment

The net carbon impact of an ICT solution is a comparison of the full life cycle carbon emissions between the selected ICT solution scenario and the reference scenario within the same boundary. The differences between these two scenarios are categorised into three different effects that are defined in the following sub-sections:

- First order effects
- 2<sup>nd</sup> order effects
- Higher order effects

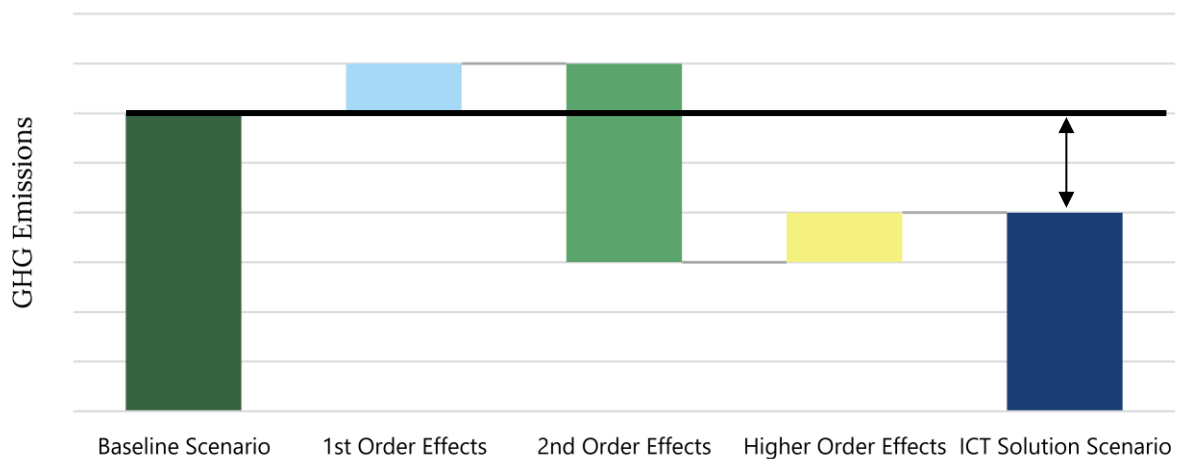


Figure 2: Example of a Positive Net Carbon Impact

Figure 2 demonstrates an example of a positive net carbon impact where emissions have been avoided between the reference scenario and ICT solution scenario. The first order and higher order effects are generating an increase in emissions and second order effects are driving the emissions reduction.

Note: ITU-T L.1480 recommendation uses the terminology “net second order effects” to represent the combined impact of first and second order effects and reports higher order effects separately. This is because higher order effects can be hard to assess and may not be included quantitatively in the assessment. To simplify terminology the EGDC methodology has opted to use the term “net carbon impact” for the assessment including impacts of all effects together but reporting where higher order effects have only been assessed qualitatively. In addition to a total net carbon impact, all effects are required to be reported separately.

### 2.3.1. First Order Effects

First order effects are the direct impacts associated with the life cycle of the ICT solution. The solution may comprise several ICT and non-ICT components that need to be assessed. First order effects are termed as solution emissions in The Avoided Emissions Framework<sup>10</sup> and are commonly referred to as a footprint. The only impacts quantified by this methodology are GHG emissions. Other impacts, such as ozone depletion or water pollution, should be qualitatively considered as part of Do No Significant Harm (see Section 3.9.1).

<sup>10</sup> Mission Innovation, 2020. [Module 2: The Avoided Emissions Framework \(AEF\)](#)

**ITU-T L.1480 definition of first order effects:** Direct environmental effect associated with the physical existence of an ICT solution, i.e., the raw materials acquisition, production, use and end-of-life treatment stages, and generic processes supporting those including the use of energy and transportation.

## 2.3.2. Second Order Effects

Second order effects are the indirect impacts that occur as a result of changes to the reference activities following the deployment and use of the solution. These effects result from the modification or replacement of the reference activities or additional activities that result from the solution implementation and the impacts are the resulting changes in GHG emissions. Their impacts can be positive (i.e. an emissions reduction) or negative (i.e. where additional activities occur, or existing activities are modified to increase GHG emissions).

For example, an e-commerce solution has a positive second order effect of reduced travel of customers to the retail premises, but it also requires delivery of the goods to the customer, which is a negative second order effect. Additional second order effects of online shopping could be more packaging and additional treatment of waste.

**ITU-T L.1480 definition of second order effects:** The indirect impact created by the use and application of ICTs which includes changes of environmental load due to the use of ICTs that could be positive or negative. *NOTE: Second order effects can be either actual or potential.*

## 2.3.3. Higher Order Effects

Higher order effects are indirect impacts that occur as a consequence of the second order effects and often occur following behavioural or structural changes, such as changes in consumption patterns, lifestyles, and value systems in order to have an impact. These effects can be positive or negative and they include, but are not limited to, rebound effects. Higher order effects occur as causal chains of actions resulting from the second order effects, the further these chains are followed the more the uncertainty of the effect increases. Similarly, the delineation between second order effects and higher order effects can be unclear, second order effects are linked to each other just as higher order effects are. The correct categorisation of effects is less important than ensuring all effects are identified and assessed.

An example of a positive higher order effect is an increased consumer uptake of low-carbon products as the benefits derived from the second order effects increase popularity of green consumerism and drive widespread purchasing behaviour changes. Negative GHG impacts from higher order effects often occur through rebound effects that induce an increase in an existing activity or generate additional activities with GHG impacts.

**ITU-T L.1480 definition of higher order effects:** The indirect effect (including but not limited to rebound effects) other than first and second order effects occurring through changes in consumption patterns, lifestyles and value systems.

## Rebound Effects

Consideration of only the first and second order effects of a solution can result in assessments of overwhelmingly net positive impacts of ICT solutions, however, the scale of these benefits are not always realised as we adapt to the new scenario that the ICT solution creates. Negative impacts typically occur as rebound effects that cause an increase in consumption due to improved efficiency of resource use, for example, an efficient product is cheaper to operate, and hence is operated more. The improved efficiency is not limited to cost, but can be any resource, such as materials, time, cost, or space. Rebound effects can increase first order effects (i.e. induce additional demand for the ICT solution) which are termed rebound usages, or they can generate additional GHG emitting activities, both of which act to reduce the net carbon impact of the solution.

Rebound effects have further categorisations (such as direct and indirect) however this methodology addresses them generally as rebound effects to maintain simplicity. ITU-T L.1480 uses further categorisation of the different rebounds and can be referred to for further details.

## Rebound effect examples

The improved efficiency of a logistics vehicle fleet due to a route optimisation solution can result in the fleet undertaking more delivery services within its operational schedules increasing GHG emissions from the fleet. This increased efficiency can also lead to a lower service cost for customers, increasing demand, and leading to growth of the organisation and of the overall logistics vehicle fleet.

A teleconferencing solution substituting business travel could allow a flexible working week. With less commuting time required per week or month, users can decide to live further away from their office location thereby increasing their commuting activity and GHG impact. They may also choose to travel more as they can work from international locations.

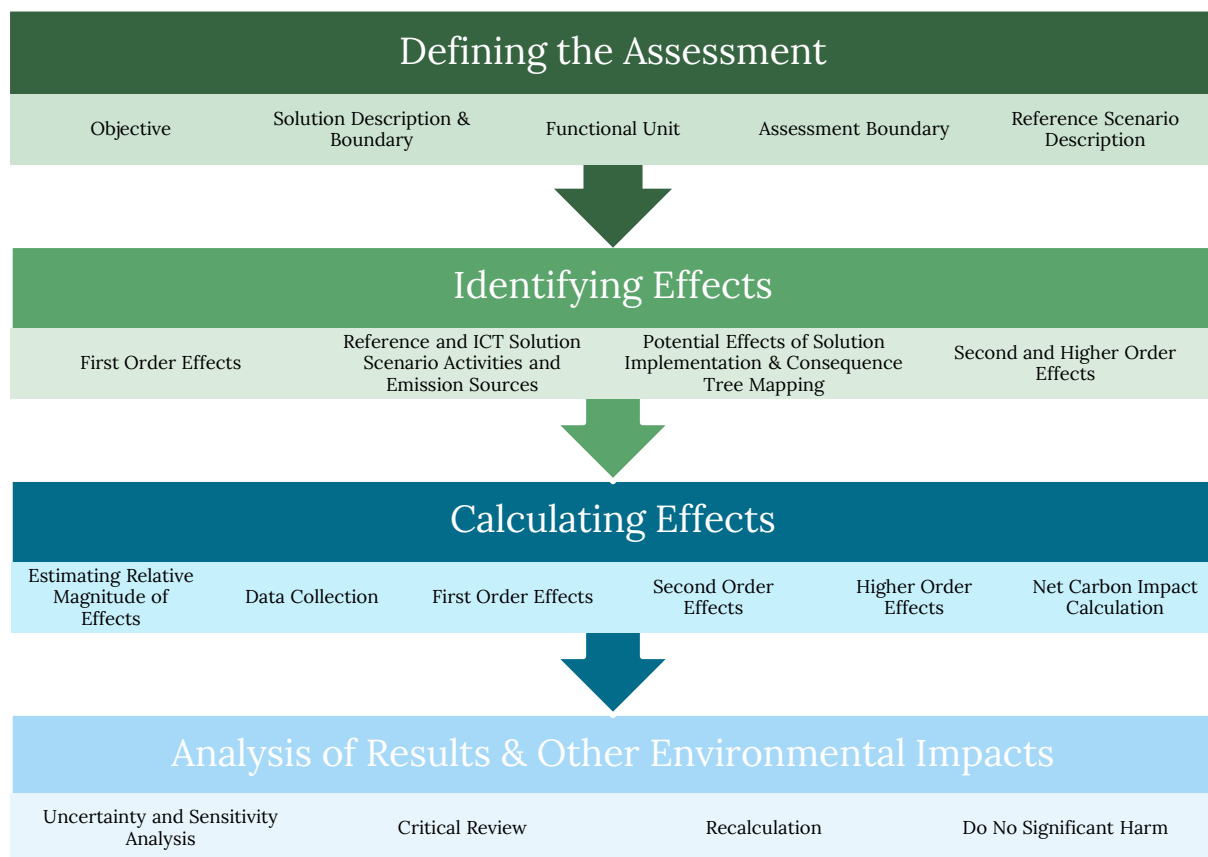
An ICT solution increases the efficiency of solar PV manufacture and decreases the cost of solar panels for customers, leading to growth of the overall solar PV market. The increased market size leads to increased solar PV production emissions. Note, these are not the first order effects of the ICT solution, but an increase in the number of solar panels produced.



## 3. Assessing the Net Carbon Impact of an ICT Solution in a Specific Implementation Context

This section will define how to assess the impact of an ICT solution in a specific implementation context and consider the impact of the solution relative to the functional unit. It includes guidance for calculating the net carbon impact within the time boundary for ex-post and ex-ante assessments and for managing changes during the time period. Section 4 will provide guidance to assessors on how and when they can use results attained in this section to assess impacts for other implementation contexts.

### 3.1. Assessment Steps



### 3.2. Defining the Assessment

A net carbon impact assessment quantifies the potential GHG impacts generated by implementing a solution in a reference scenario. Therefore, before beginning the calculation, it is necessary to fully define the solution, and the assessment criteria along with context for the purpose of the assessment. This is required to establish the

applicability of the methodology and provide a basis for the methodological decisions made and a rationale for any assumptions used.

### 3.2.1. Assessment Objective

To define the objective of the assessment the assessor should consider what the intended use of the results will be. As detailed in Section 1.3, net carbon impact assessments of an ICT solution can be used to support a range of decisions, and it is important that this is defined and agreed with all stakeholders involved in the assessment as this will not only impact the assessment approach, but also the communication of the results.

#### Requirements

The assessor shall define the following:

- (A) Assessment aim: Describe the intended use of the output from the assessment.
- (B) Assessment type: Define if the assessment will consider a single implementation context or if multiple contexts will be carried out;<sup>11</sup>
  - Assessment of a specific ICT solution implemented in a specific implementation context.
  - Assessment of a specific ICT solution with multiple implementations and may consider different scales (organisational level, city level, country level, worldwide level), see section 4 for further details.
- (C) Assessment perspective (actual/potential effect): Determine if an ex-post or ex-ante assessment is to be carried out.
  - Actual effects consider the historical effects that have occurred following solution implementation. An ex-post assessment of the solution implementation until the current point in time or after the end of its life.
  - Potential effects consider the future effects that could occur following solution implementation. An ex-ante assessment of the solution before it is implemented or from the current point in its implementation until the end of its life.

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<sup>11</sup> ITU-T L.1480 defines a third assessment type in addition to the two above named “assessment of specific ICT solutions from the perspective of an ICT organization contributing to ICT solution”. L.1480 doesn’t include any differentiation in approach or requirements for these types of assessment and so this methodology has incorporated the guidance within the two above assessment types. Also note, that L.1480 allows for assessment of multiple ICT solutions simultaneously which is out of scope of this methodology.



## 3.2.2. Solution Description & Boundary

### Requirements

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

- (A) A description of the ICT solution and its functionality.
- (B) The key mechanism(s) by which the ICT solution is expected to result in changes to GHG emissions.
- (C) The sector(s) in which the ICT solution is expected to be implemented.
- (D) Any limitations to the use of the solution (e.g., geographical, technical, operational, etc.).
- (E) The ICT solution boundary as a description of all components comprising the solution.

The descriptions of the solution requirements should be completed at the start of the net carbon impact assessment but will likely need to be updated and complimented with additional information throughout, and at the end of the assessment.

### Guidance

#### Requirement 3.2.2 (A)

A solution typically has multiple functions and each function could have different effects on the reference scenario. The assessor should describe all functions relevant to the implementation being assessed by consideration of all functions provided by the solution, in order to prevent missing interactions with the existing system. For example, a building management system functionality could include controls for heating, cooling, lighting, and responsive demand (e.g., EV charging).

#### Requirement 3.2.2 (E)

The boundary of the assessment shall include the full ICT solution with all solution components necessary for its functionality. Typically, ICT solutions are comprised of multiple components necessary for a full functioning solution. Section 2.1 described in detail possible components of an ICT solution which may include (but are not limited to) hardware for data collection, data processing, and user controls, control systems and actuators, software, telecommunication network infrastructure, and remote data storage and processing.

Descriptions shall be provided for all components of the ICT solution necessary for the functioning of the end-service to the user. This should include all solution components (digital and non-digital), regardless of if they have been modified since the reference scenario or not. As all components are likely to evolve over time, the description is only required to identify the component, but it is not necessary to detail different versions or technological changes unless this is relevant to the assessment.

## 3.2.3. Functional Unit

### Requirements

- (A) The functional unit for the assessment shall be defined including descriptions of its:
- (i) Function relevant to both reference and ICT solution scenarios
  - (ii) Unit quantity
  - (iii) Performance

This allows all inputs and activities involved in the assessment to be normalised to the same reference quantity and is necessary to ensure comparability of the results from each scenario.

### Guidance

#### Requirement 3.2.3 (A)

The functional unit defines the function that both the ICT solution scenario and the reference scenario deliver and must be a measurable entity. The function shall be defined in terms of a unit quantity and performance. While being applicable to both the reference and ICT solution scenarios, the function should be aligned to the customer or end-users experience of the service.

For example, the function of an ICT solution that monitors patient health is the maintenance of patient health assessed per health incident (unit quantity), the function is not the use of the monitoring system itself as this does not occur in the reference scenario.

Defining the performance of the function is necessary to define the operational requirements to achieve the unit quantity of the service. Often this requires definition of the time period that the function relates to but is not always necessary.

#### Examples

For example, the functional unit for a building management system (BMS) solution for heating and cooling could be the maintenance of a comfortable temperature:

<b>Function</b>	Temperature management service
<b>Unit Quantity</b>	Per square metre
<b>Performance</b>	Maintain the building at 21 °C for a period of one year

For example, the functional unit for an e-learning solution could be:

<b>Function</b>	Learning service
<b>Unit Quantity</b>	Per user of the learning service

<b>Performance</b>	A user completing a 12-hour learning module
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For example, the functional unit for a fugitive gas monitoring solution could be:

<b>Function</b>	Gas leakage control
<b>Unit Quantity</b>	Leakage per metre of pipe
<b>Performance</b>	Fully charged fugitive system operating 24 hours/day

### 3.2.4. Assessment Boundary

#### Requirements

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 CO<sub>2</sub>e value in alignment with common greenhouse gas reporting standards.
- (B) The assessor shall define the time boundary for the assessment.
- (C) The assessor shall define the geographical boundary for the assessment.
- (D) The assessor shall define the implementation context for the assessment.

#### Guidance

##### Requirement 3.2.4 (A)

The boundary of the assessment includes Kyoto Protocol gases at a minimum to align with existing standards (GHG Protocol Corporate Standard, ISO 14067). Assessments can include impacts of other gases covered in the Montreal Protocol, or other effects such as surface albedo changes and atmospheric water vapour, which should be reported separately and explicitly stated when reporting the assessment boundary.

##### Requirement 3.2.4 (B)

The assessor shall define the time boundary for the assessment. For example, the assessor could choose to assess the impact of the solution in the last calendar year or could assess the potential impact over the next 3 years. If the assessment estimates the actual historical impact of an ICT solution it is an “ex-post assessment” which assesses the solution during a time period between its implementation and the current point in time or the end of its life. Alternatively, if the assessment estimates the potential future impact, it is an “ex-ante

assessment” that assesses the solution during a time period between the current point in time and the end of its life.<sup>12</sup>

Ex-post assessments should be used when assessing the actual impact of deployed solutions and for public reporting of net carbon impacts. The time boundary for these assessments can be for the full lifetime of the solution until the point in time of the assessment (i.e. the cumulative impact over the lifetime), or they can be specified for a shorter period of time (e.g. annual reporting).

Ex-ante assessments are used to assess potential future impacts and are therefore based on assumptions of future conditions and performance. These assessments are useful to gain insights into potential future activities (e.g. potential solution deployments) and should be used for strategic and decision-making purposes. These should not be used for public reporting of net carbon impacts as the assessment contains significant uncertainty around impacts due to the use of historical data as a proxy for future performance and future contextual changes.

When selecting the time boundary, the assessor should consider changes that can occur over the period of the assessment and ensure that changes that would significantly affect the outcome of the assessment can be adequately assessed.

**Box 3.2.1 Example change of a calculation parameter:** *Published electricity grid emission factors change annually, in an ex-ante assessment the effect of future changes to the electricity grid emission factors may be significant. The assessment shall ensure that the factors can be adequately estimated for the full time period of the assessment. If this is not feasible, the assessor may need to reduce the time period of the assessment to allow for adequate estimation of these factors.*

**Box 3.2.2 Example change of reference scenario:** *The alternatives to the assessed ICT solution can change during its lifetime and necessitate a change to the reference scenario (section 3.2.5). The assessment should be split into multiple time periods as necessary to ensure that each time period is limited to one reference scenario, for further guidance see section 3.5.2.*

## Requirement 3.2.4 (C)

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<sup>12</sup> ITU-T L.1480 uses the terminology “mid-way” to refer to an assessment of a present situation during the lifetime of the solution. As mid-way can be either an estimated historical impact (ex-post), or an estimated potential future impact (ex-ante) this additional categorisation has not been adopted by this methodology.

The geographical boundary of the assessment in relation to the implementation of the solution may be a region or a country where the activities in the reference and ICT solution scenarios take place. While the geographical boundary refers to the region where the activities take place, it does not limit the inclusion of upstream activities within the calculation if they occur outside of the selected boundary, i.e., if resources are sourced from outside the boundary they shall not be excluded from the assessment. The geographical boundary must be applied consistently throughout the assessment.

## **Requirement 3.2.4 (D)**

The implementation context is the system in which the solution is applied. The implementation context must be defined to ensure that necessary parameters in the reference and ICT solution scenarios are kept constant throughout the assessment and ensures comparability between the scenarios. The description of the system should be as explicit as possible and, where possible, any characteristic which has a key influence on the result of the assessment should be treated as a parameter in the assessment (this will facilitate the extension to other implementation contexts). Other contextual factors that cannot be defined as a parameter should be described.

To define the implementation context, it is useful to determine the system in which the solution is being applied and consider the reference activities that are modified or replaced. Implementations can occur at different scales, such as within an organisation, a city, or a region, where they affect a specific set of activities. Multiple implementation contexts are required when the solution will have different impacts on the reference activities described in the system. This section considers a specific implementation context, however, the assessor shall consider if multiple implementation contexts are necessary to achieve the objective of the assessment. If multiple contexts are required, the assessment of a specific context can be repeated for each context, or Section 4 can be used to determine whether the results of the net carbon impact in one implementation context can be used in other implementation contexts.

Other contextual factors also need to be considered. ITU-T L.1480 considers these separately as it does not include the concept of an implementation context. This standard lists the following types of contextual factors and the different stakeholder perspectives that should be used to consider them by.

### **Box 3.2.3 - Example of a key implementation parameter**

A common characteristic that drives multiple implementation contexts is the geographical boundary of the assessment. If the solution is implemented in multiple locations, it is likely that external factors affecting GHG impacts will differ. For example, electricity emissions intensity varies across electricity grids and therefore, even if electricity consumption was constant between the implementation contexts, the GHG impacts would be different.

Contextual factors:

- Economic obstacles and incentives
- Business obstacles and incentives
- Structural obstacles and incentives
- Social obstacles and incentives
- Attitudes and behaviours

Stakeholder perspectives:

- End users
- ICT operators and vendors
- Investors
- Policy makers
- Society

### 3.2.4 Example: Building management system solution

Referring to the previous BMS example in section 2.2.4, the implementation context is the new office building in Berlin with 8 floors of 2,000 square metres each, office open hours of 7am – 9pm and the external temperatures experienced during the time period. Other contextual factors include attitudes towards internal temperature set point and financial incentives to reduce operational costs. If an organisation has implemented the solution in multiple similar buildings in the same region, they could be determined to all be adequately represented by the same implementation context that includes multiple buildings (organisational scale). However, if the similar buildings occurred in significantly different locations, then multiple implementation contexts would be required as the impact of the solution would vary.

### 3.2.5 Example: Remote patient monitoring solution

The implementation context for a remote patient monitoring solution is likely to be selected at a regional or country scale, such as patients in the United Kingdom with a specific health condition. Other contextual factors include attitudes to visiting a medical professional, and access to transport. Considering each patient as a single implementation context would have limited data to assess the GHG impacts of the effects accurately and so the implementation context is selected to consider the common user group of the solution that have similar activities, which is better represented at a regional or country scale.

### 3.2.6 Example: Fleet management solution

A fleet management solution implemented in an organisation will affect all vehicle fleet activities. As the organisation has a diverse range of vehicles with different journey types, the solution will generate different GHG impacts for its heavy goods vehicle fleet versus its van fleet. Therefore, the assessment needs to consider the different vehicle types as different implementation contexts. These individual contexts could both consider the fleet fuel types, number of vehicles in the fleet, average vehicle loading, average operations schedule, and average journey type. Other contextual factors include fuel pricing and regional air quality restrictions on vehicles.

## 3.2.5. Reference Scenario Definition

The determination of the reference scenario directly impacts the accuracy and credibility of a net carbon impact assessment and therefore it is critical for the assessor to correctly identify the reference scenario and justify the selection. Due to the inherent uncertainty, it is important to adopt a conservative approach. As the reference scenario conditions are likely to change over time, it is necessary to re-assess it periodically, which is addressed in section 3.8. Given the importance of the reference scenario for the assessment's results, transparency of the decisions and assumptions are necessary to ensure the assessment is credible.

### Requirements

- (A) The reference scenario shall be determined as 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.
- (C) The reference scenario shall include multiple scenarios if necessary to accurately represent the most likely alternative scenario.
- (D) The assessor shall describe how the function is fulfilled in the reference scenario.

## Guidance

### Requirement 3.2.5 (A)

The most likely alternative scenario definition is intended to represent the most likely GHG emissions scenario that would occur if the solution was not used<sup>13,14</sup>. The most likely alternative scenario is the most likely method the solution users would select in the absence of the ICT solution, which can also be described as the business-as-usual scenario. Therefore, if use of the ICT solution being assessed is considered business-as-usual in the relevant time and implementation context, the assessment shall result in a neutral impact as the reference scenario and ICT solution scenario are the same. Over time ICT solutions can become business-as-usual and the initial positive impacts are diminished until they become neutral or negative impacts. Assessment of what is considered business-as-usual is usually qualitative, however, it can be supported by secondary data from the appropriate region, e.g. market-share of a solution. For example, in many developed economies the use of video conferencing systems could not be claimed to substitute travel as they have become a business-as-usual solution. This judgement is subjective, and assessors should be conservative in their approach to applying this criterion to ensure that the results of the net carbon impact assessment retain credibility.

The reference scenario shall be selected so that it has equivalent or less functionality than the ICT solution scenario, but it cannot have more. This is to ensure that any emissions reductions are as a result of an improvement due to the ICT solution and not lower functionality of the ICT solution scenario. The methodology intent is not to compare two of the same solution from different organisations.

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<sup>13</sup> The most likely alternative definition is aligned with both ITU-T L.1480 that requires “the most probable reference scenario” and WBCSD Guidance on Avoided Emissions that requires “the most likely alternative scenario”.

<sup>14</sup> For an explanation of why these criteria were selected please refer to Appendix 6: Reference Scenario Selection.

The implementation context must be considered to select the reference scenario correctly as it identifies the solution users and environment in the most likely alternative scenario. Considering an example of a soil moisture management solution that monitors and controls moisture soil levels, the implementation context may differ between countries. In one country the most likely alternative may be an automated moisture measurement without a control system, where in another country the most likely alternative may be completely manual (i.e. no ICT solution at all). Therefore, multiple reference scenarios may be required to assess multiple implementation contexts, further guidance is provided in section 4.

The reference scenario must also be relevant to the time period in which the solution is being assessed, and different reference scenarios may be required to cover the full time period of the assessment as discussed in requirement 3.2.4 (B). As the reference scenario can change over time this is also considered when recalculating an assessment (section 3.8).

### **Requirement 3.2.5 (B)(i)**

Continued use of the known system that was previously in place is applicable when:

- An existing system is being optimised by an ICT solution, e.g. a fleet management system is being implemented to optimise operations of a vehicle fleet which is known to have been previously managed manually.
- An ICT solution is substituting a single and known previous method for achieving the service, e.g. gaming digital download is replacing physical discs, the reference scenario is known as the physical disc.

Where the previous system is known for all end users of the ICT solution, the most likely alternative is the continued use of the previous system. If the previous system is at the end of its life and is due for replacement (ii) should be used as the previous system was not going to be continued. To select this reference scenario the previous system must be known for all end users and implementations to be included in the assessment. If multiple reference scenarios exist this reference scenario can only be selected where all previous systems are known, otherwise (ii) should be used.

The known system may or may not include an ICT solution. Where a previous ICT solution was present in the reference scenario and is being replaced by a new ICT solution, the previous solution must be included in the reference scenario.

### **Requirement 3.2.5 (B)(ii)**

Use of the average alternative solution/method that solution users would select to achieve the same service should be used when the previous system is unknown:

- A new system is being installed with an ICT solution.

- E.g. a new manufacturing line is being setup with a high functionality quality control system, the reference scenario is selected as the new manufacturing line with the average quality control system available on the market.
- When an existing system is at the end-of-life and being replaced, this must be treated as a new system being installed as continued use of the known system is not a possible scenario. E.g. an old manufacturing line is removed for installation of the new manufacturing line, the average alternative solution/method must be used as the reference scenario as the previous line no longer exists.
- An ICT solution is substituting alternative methods of achieving the service.
  - E.g. a remote patient monitoring system is used by a diverse user group where the prior method for each user is unknown, the reference scenario is selected as user travel for appointments as the most likely alternative method for receiving a check-up.

The average alternative solution/method that solution users would most likely select is dependent on their situation. In case of a purchasing decision between new ICT solutions of different functionalities, the average alternative is the market average solution relevant to the given implementation context and time of the assessment, not simply the average solution available for purchase. It is useful to consider similar products/services that the solution users could choose. Potential sources for defining the market average are national statistics, surveys, market research, or other publications considering how services are delivered to end users.

## Note on EU Taxonomy alignment

The EU Taxonomy substantial contribution criteria for data-driven solutions for GHG emissions reductions requirement:

*“Where an alternative solution/technology is already available on the market, the ICT solution demonstrates substantial life-cycle GHG emission savings compared to the best performing alternative solution/technology”*

For assessment to align to the EU Taxonomy the best performing alternative solution must be used and not the market average solution. For reasoning why this approach was not adopted for all assessments see Appendix 6: Reference Scenario Selection.

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<sup>15</sup> EU taxonomy text taken from: [Data-driven solutions for GHG emissions reductions \(europa.eu\)](https://europa.eu)

Where the situation does not consider an alternative ICT solution, the average alternative shall consider the most likely alternative method that would be selected by solution users to achieve the service. The service is the function common to both the reference and ICT solution scenarios, it is not the service delivered by the ICT solution. In the remote patient monitoring example above, the service is receiving a check-up when a health incident occurs as this is common to both scenarios.

### Requirement 3.2.5 (C)

The most likely alternative scenario may need to be defined by multiple scenarios. This may occur in situations such as multiple alternative ICT solutions are available that could be considered the market average, or there are multiple user groups for the ICT solution where no one average alternative method is evident. In these cases, the assessment should use a weighted average of the possible alternatives.

The variability among the reference scenarios should be understood so that a robust average scenario can be formulated. This can be problematic when the data availability for the reference scenario is low, in these instances the limitations of the reference scenario should be made transparent within an assessment.

### Requirement 3.2.5 (D)

To define the reference scenario the assessor shall describe how the function is delivered by the reference activities. It is useful to consider the end-user of the solution. Example descriptions of the reference scenario and ICT solution scenario:

Reference Scenario	ICT Solution Scenario
<b>A low functionality BMS solution</b> The building is controlled by a BMS solution managing the lighting via programmed schedules, with manual controls for heating and cooling.	<b>A high functionality BMS solution</b> The building is controlled by a BMS solution managing central heating, cooling, and lighting via programmed schedules.
<b>Mixed manual and automated controls</b> The passenger vehicle fleet is managed via manual scheduling and routing.  The goods vehicle fleet routing is managed via a routing solution, and the scheduling is managed manually.	<b>A fleet management solution</b> The full vehicle fleet scheduling and routing is managed by the ICT solution.
<b>Manual maintenance schedules</b> The manufacturing machinery had scheduled maintenance.	<b>A predictive maintenance solution</b>

	The manufacturing machinery maintenance is controlled by the ICT solution.
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### 3.3. Identifying Effects

After the assessment has been defined, the next step is to identify all of the effects resulting from the implementation of the ICT solution. To do this, the 5-step process below may be followed:

1. Identify reference and ICT solution scenario activities and emission sources.
2. Identify potential effects associated with the solution implementation.
3. Map the effects in a consequence tree.
4. Identify first order effects.
5. Identify second & higher order effects.

The following sections provide further detail on each step of the process.

#### 3.3.1. Identifying Reference and ICT Solution Scenario Activities and Emission Sources

##### Requirements

- (A) Identify the activities under the reference and ICT solution scenarios.
- (B) Identify potential GHG emission sources related to the activities.

##### Guidance

#### Requirement 3.3.1 (A)

The assessor should list all activities required to fulfil the defined function provided under the specified assessment boundary under both the reference and ICT solution scenarios. It may also be useful to graphically represent the activities in a process flow diagram or similar.

To identify the activities, a comprehensive understanding of the end-to-end process is required. At this stage the assessor should aim to identify as many activities as possible even if they are considered unlikely to be affected by the solution implementation or if they have no GHG impacts. Thoroughly mapping the end-to-end activities of both scenarios can help ensure that no activities and GHG impacts are missed. When identifying necessary

activities, it may be useful to consider the end user and what conditions or activities are necessary for them to achieve the intended outcome.

ICT solutions that optimise the reference activities will have the same activities between the reference and ICT solution scenarios, but the reference activities are modified in the ICT solution scenario. ICT solutions that substitute the reference activities will result in different activities between the reference scenario and ICT solution scenario. In situations of partial substitution, the ICT solution scenario must include the continued activities from the reference scenario in a modified form. To illustrate this, consider a recent e-commerce solution implementation in addition to the organisation's retail premises in Box 3.3.1 - Table 1. As a partial substitution, all of the reference scenario activities occur in the ICT solution scenario, however, some have been modified, and new activities added.

The assessor should consider what subsequent activities are required for the service defined in the functional unit to be completed for the user. In the e-commerce example, additional activities are necessary for deliveries of purchased goods to the customer. The activities generated by the solution may result in other subsequent activities that need to be identified, in the example, due to the increased home deliveries there are additional return deliveries.

Box 3.3.1 - Table 1: Activities under the reference and ICT solution scenarios for an e-commerce solution

Reference scenario	ICT solution scenario
Manufacturing of goods	Manufacturing of goods
Transportation of goods to warehouse	Transportation of goods to warehouse
Storing of goods in warehouse	Storing of goods in warehouse
Transportation of goods to shop	Transportation of goods to shop (modified)
Going to the shop	Going to shop (modified)
Goods purchased from shop	Goods purchased from shop (modified)
Return from shop	Return from shop (modified)
	Purchasing goods online (new)
	Delivery transportation of goods from warehouse to customer (new)
	Return transportation of goods from customer to warehouse (new)

## Requirement 3.3.1 (B)

Once the activities have been identified they shall be assessed if they have any associated potential GHG emissions. At this stage the assessor should consider any GHG emissions that could result from the activity and not try to infer any likely impact to ensure that all GHG emission sources are identified. The example from Box 3.3.1 - Table 1 is continued in Box 3.3.2 - Table 2.

Box 3.3.2 - Table 2: Scenario activities with potential GHG emissions for an e-commerce solution.

Reference scenario	Potential emissions	ICT solution scenario	Potential emissions
Manufacturing of goods	Embodied emissions of product	Manufacturing of goods	Embodied emissions of product
Transportation of goods to warehouse	Transport emissions	Transportation of goods to warehouse	Transport emissions
Storing of goods in warehouse	Warehouse emissions	Storing of goods in warehouse	Warehouse emissions
Transportation of goods to shop	Transport emissions	Transportation of goods to shop (modified)	Transport emissions
Going to the shop	Transport emissions	Going to shop (modified)	Transport emissions
Goods purchased from shop	Shop emissions	Goods purchased from shop (modified)	Shop emissions
Return from shop	Transport emissions	Return from shop (modified)	Transport emissions
		Purchasing goods online (new)	Laptop emissions Network emissions Home emissions
		Delivery transportation of goods from warehouse to customer (new)	Transport emissions
		Return transportation of goods from customer to warehouse (new)	Transport emissions

## 3.3.2. Identifying Potential Effects of Solution Implementation

### Requirements



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

## Guidance

### Requirement 3.3.2 (A)

Assess all identified activities to determine whether the solution implementation is likely to result in a change in activity that could have a GHG impact and describe the likely effect. All new activities with identified emissions will have an associated effect. Examples of identified effects for an e-commerce solution is provided in Box 3.3.3 Table 3.

This step is to identify any changes that could occur to the activities between the reference and ICT solution scenarios as a result of the solution implementation. Initial second order effects can be identified by considering changes between the scenarios. As second order and higher order effects occur as causal chains, these changes should then be further assessed to identify other second or higher order effects that result from implementation. The consequence tree is an essential tool to identify other effects and should be used in tandem with this step. It is important not to consider this identification alone as sufficient to identify all effects relevant to the assessment.



Box 3.3.3 Table 3: Initial identification of effects for an e-commerce solution

Reference scenario	Potential emissions	ICT solution scenario	Potential emissions	Identified Effect
Manufacturing of goods	Embodied emissions of product	Manufacturing of goods	Embodied emissions of product	No change in manufacturing of product
Transportation of goods to warehouse	Transport emissions	Transportation of goods to warehouse	Transport emissions	No change in transport of products to warehouse
Storing of goods in warehouse	Warehouse emissions	Storing of goods in warehouse	Warehouse emissions	No change in products stored in warehouse
Transportation of goods to shop	Transport emissions	Transportation of goods to shop (modified)	Transport emissions	Reduction in transport of goods to the shop
Going to the shop	Transport emissions	Going to shop (modified)	Transport emissions	Reduction in travel to the shop
Goods purchased from shop	Shop emissions	Goods purchased from shop (modified)	Shop emissions	Reduction in products purchased from shop
Return from shop	Transport emissions	Return from shop (modified)	Transport emissions	Reduction in travel from the shop
		Purchasing goods online (new)	Laptop emissions Network emissions Home emissions	Additional emissions from laptop and network emissions
		Delivery transportation of goods from warehouse to customer (new)	Transport emissions	Additional emissions from transport of goods to the customer

### 3.3.3. Mapping Effects in a Consequence Tree

#### Requirements

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

#### Guidance

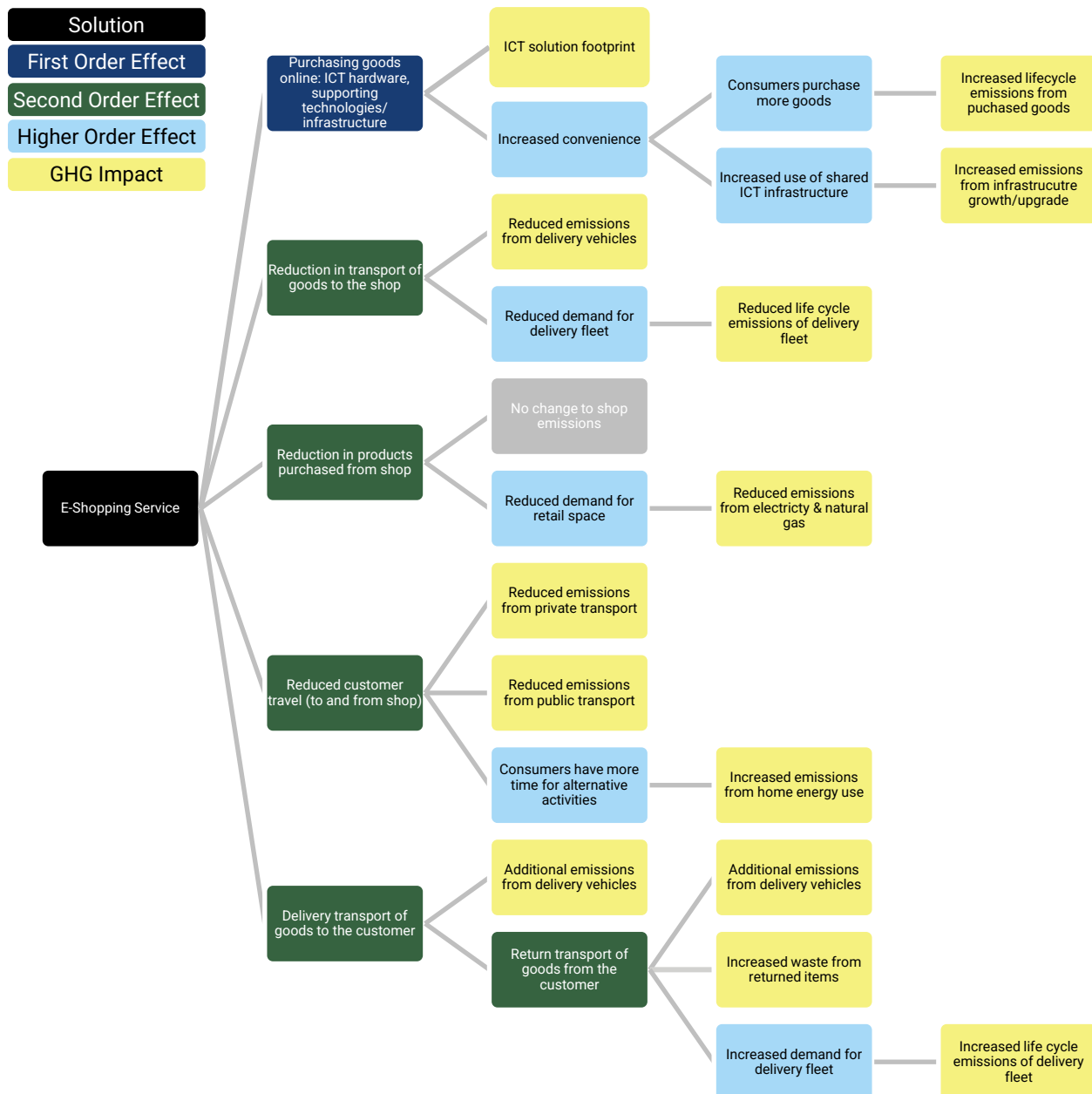
#### Requirement 3.3.3 (A)

First order effects can be identified by considering the ICT solution that generates new or modified activities between the scenarios. Second order effects and higher order effects occur as causal chains of effects that result as a consequence of the ICT solution implementation. A consequence tree provides an analytical approach to identify these second and higher order effects. The identified effects from the previous steps are used as a basis to consider the consequences of implementation and aid identification of additional effects. For each effect a causal chain of subsequent effects should be generated, including considering effects that can occur over a longer timeframe. The GHG impact of each effect should be included where they occur. Non-GHG impacts can also be included in the tree to identify any other unintended environmental consequences. A continuation of the e-commerce example is provided in *Figure 3*.

The following sections (Sections 3.3.4 and 3.3.5) provide guidance on identifying and categorising first, second, and higher order effects and may need to be iterated and reviewed in tandem with this step.



Figure 3: Example consequence tree for an e-commerce solution



### 3.3.4. Identify First Order Effects

#### Requirements

- (A) All first order effects shall be identified that occur within the boundary of the ICT solution as defined in section 3.2.2

- (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 the 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.

## Guidance

### Requirement (A)

Section 3.2.2 describes all of the components comprising the ICT solution. The first order effects are the life cycle impacts resulting from these solution components. ICT solutions are composed of many components and are not limited to the hardware and software components that would be apparent to the customer. The full solution must include any supporting infrastructure and technologies.

### Requirement 3.3.4 (A)(B)

For each solution component, the GHG impacts associated with all life cycle processes shall be identified including raw material acquisition, manufacture, transportation, operation, maintenance, end-of-life, and generic processes such as transportation and waste treatment. When considering emissions resulting from the consumption of resources of a life cycle process (e.g. fuel combustion for transport) the upstream emissions of the resource should be included as well as the operational emissions (e.g. fuel well-to-tank and combustion emissions). In order to identify all relevant activities and GHG effects it can be useful to map the key life cycle processes in a linear flow and consider the inputs, processes, outputs, and effects relating to each activity. For further guidance refer to existing LCA methodologies as described in section 3.4.3.

### Requirement 3.3.4 (C)

Components defined within the solution boundary may already exist prior to implementation of the ICT solution, and therefore the associated embodied and end-of-life emissions of these components occur in the reference scenario and should be excluded from assessment of first order effects. Embodied emissions include emissions from all upstream life cycle processes before operation of the solution component. This is commonly the case for shared infrastructure such as telecommunications network infrastructure and cloud computing services but is also relevant for hardware components. See example Box 3.3.4.

## Box 3.3.4 - Example: Infrastructure and hardware exclusion

A high functionality BMS solution is implemented to replace an old BMS system of lower functionality. The solution boundary (3.2.2) includes control units, sensors, local communication hardware, cabling, software, computing hardware (laptop), telecommunication network infrastructure, and cloud computing infrastructure.

First order effects included in the assessment:

- Full life cycle GHG impacts of control units, sensors, local communication hardware, cabling, and software.
- Use-phase GHG impacts of computing hardware (laptop), telecommunication network infrastructure, and cloud computing infrastructure.

First order effects excluded from the assessment:

- Embodied and end-of-life GHG impacts of computing hardware (laptop), telecommunication network infrastructure, and cloud computing infrastructure.

### Justification

Computing hardware (laptop): The software user interface for the new BMS solution is installed onto existing computing hardware owned by the organisation.

Telecommunication network infrastructure, and cloud computing infrastructure: The ICT solution has used existing cloud computing infrastructure for data storage and processing and the existing telecommunication network infrastructure for data transmission between the cloud and local network. The multiplying effect of ICT solutions generating increased demand for more shared infrastructure and services will be considered as a higher order effect in the assessment and not as a first order effect.

## 3.3.5. Identify Second & Higher Order Effects

### Requirements

- (A) All second order effects shall be identified.
- (B) All higher order effects shall be identified.

### Guidance

#### Requirement 3.3.5 (A)(B)

The second order effects of the solution include the intended outcome(s) of the ICT solution which should be self-evident, however, the solution can have other second order or higher order effects that are more challenging to identify. This requires an analytical approach which is provided by the previous step (3.3.3) that occurs in parallel with this one.

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The set of specific and identifiable consequences can potentially be very large. Assessors should consider the population of users of the solution and which specific and identifiable instances can occur, to form the basis for the assessment. It is important to include all potential effects to ensure that the net carbon impact assessment is credible and valid.

All effects should be categorised as second order or higher order effects according to their definitions in section 2.3. Occasionally categorising an effect as either second order or higher order can be challenging, the most important aspect is that the effect is identified and included in the assessment.

Higher order effects resulting from the solution implementation can be the most challenging to identify. In particular the effects that occur over a longer timeframe are unlikely to be discovered during the initial identification but should be captured while creating the consequence tree. Useful higher order effects that should be considered are rebound effects, effects of lock-in, or cumulative effects of ICT growth.

As rebound effects are a common type of higher order effect, the assessor should consider what rebound effects could occur as a result of the solution implementation. The following questions can be useful to consider:

- How does the solution interact with the user, does it generate resource / financial / time / space savings? If so, are the savings likely to be used for other **specific** and **identifiable** products/services/activities?
- What are the potential behavioural impacts in response to the solution's implementation context? Is the product / service / activity that the solution targets likely to be used more because it is cheaper or more convenient?
- Are there immediate rebound effects (i.e. short term) that can be identified? If so, what other potential impacts could materialise with increased solution adoption over time?

A significant higher order effect for consideration is the potential for lock-in to fossil-fuelled assets. This can occur where an efficiency gain of a fossil-fuelled activity prolongs the lifetime or reliance on the asset that consumes fossil fuels and prevents its replacement by a non-fossil fuelled asset. Similarly, if a solution could have structural effects on the fossil fuel industry, such as increasing the efficiency or reducing costs for fossil fuel exploration and extraction, which could lead to increased production of fossil fuels and increased GHG emissions.

The cumulative effect of ICT growth is a common higher order effect where the overall increase in the use of ICT results in expansion of shared ICT infrastructure. Each ICT solution contributes to this cumulative effect, and it should be considered as part of the assessment.



## Box 3.3.5 Example: E-commerce (continued)

The e-commerce example provided in Figure 3 demonstrates that solution implementations generate multiple positive and negative effects and the highlights the importance of an analytical approach to include all effects in the assessment. Alongside the expected positive GHG impact of reduced customer travel several other effects have been identified:

- Reduced customer travel to the shop
  - Reduced emissions from private and public transport.
  - Customers have more time for alternative activities that could result in additional GHG emissions.
- Reduction in transport of goods to the shop
  - Reduced transport emissions.
  - Reduced demand for delivery fleet leading to reduced life cycle emissions of the fleet.
- Reduced goods purchased in the shop.
  - No reduction in operational emissions of the shop as the opening hours remain the same.
  - Over a longer timeframe there may be a reduced demand for retail space due to an increase in e-commerce.
- Additional activities are necessary for the transport of goods to and from the customer and waste from delivery packaging.
  - Additional transport emissions for delivery and returns.
  - Additional emissions from the transport and processing of waste.
  - Increased demand for delivery fleet leading to increased life cycle emissions of the fleet.
- Increased convenience of e-commerce can lead to consumers purchasing more goods in total.
  - Increase in total goods life cycle emissions.

## 3.4. Calculating Effects

### 3.4.1. Estimating the Relative Magnitude of Effects

#### Requirements

- (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.

#### Guidance

## Requirement 3.4.1 (A)

An assessment of the relative magnitude of all GHG impacts of effects shall include a quantitative estimation of the GHG impact where feasible, or a qualitative assessment of the potential GHG impact where estimation is not possible at this early stage. The estimation should consider the magnitude of the effect relative to the total net carbon impact, e.g. as a percentage. Estimating the relative magnitude of the identified GHG impacts will help to establish the necessary data requirements for the calculations and can be used to justify exclusion of effects according to the cut-off criteria. This allows organisations to focus resources effectively on the most significant elements of the analysis.

The output should document the estimated relative magnitude of all identified effects and key methodological and data decisions. The relative magnitude may need to be updated iteratively throughout the assessment as early estimations are replaced by primary data. Once the net carbon impact assessment is completed the estimation should be repeated with the final emissions for each effect to validate any cut-offs and data selection choices.

As data availability may be a limiting factor for many organisations to make specific calculations, a qualitative assessment can consider the potential order of magnitude of a GHG impact relative to the magnitude of other identified first, second, or higher order effects. In this approach, the significance of each effect (e.g. low, medium, or high) should be estimated and supported by an explanation.

If an effect is significant, it may be useful to carry out another assessment specific to the activity to identify the most significant elements of the effect and focus data collection efforts. For example, if the embodied emissions of the solution were calculated to be significant, a materiality assessment of the solution's components could identify a small number of components as significant and necessitating the collection of primary data.

## 3.4.2. Data Collection

### 3.4.2.1. Identifying Key Activities for each Effect

#### Requirements

- (A) For all effects identified under section 3.3, suitable activities and activity emission factors should be identified that can be used to estimate the GHG impact of each effect.

#### Guidance

### Requirement 3.4.2.1 (A)

The identification of effects (first, second, and higher order) by consideration of the reference and ICT solution scenarios will define the activities that require a calculation to

assess the GHG impact. For each effect the activity that is either modified, substituted, or additional will define the necessary data collection, but there may be several methods to calculate the impact.

### Box 3.4.1 – Example

A reduction in passenger car travel could consider either distance reduced, or fuel saved:

- Distance (km) travelled in a passenger car during the reference and ICT solution scenarios:
  - Distance travelled by each vehicle (km)
  - Vehicle type: Small / medium / large passenger car
  - Fuel type: Petrol / diesel / hybrid / plug-in hybrid / BEV
  - Emissions per km for different vehicle and fuel types (kgCO<sub>2</sub>e/km)
- Fuel (litres) used in a passenger car during customer travel during the reference and ICT solution scenarios:
  - Fuel used by each vehicle (litres)
  - Emissions per litre of petrol (kgCO<sub>2</sub>e/litre)

Note that this example assesses the effect of transport in the implementation context of a passenger car. In the case of multiple implementation contexts (e.g. a van as a different vehicle type), this has to be considered when identifying suitable activities and the associated activity emission factors.

### 3.4.2.2. Data Quality and Availability Assessment

#### Requirements

- (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.

## Guidance

### Requirement 3.4.2.2 (A)(B)(i)

For each activity and associated emissions factor, an assessment of the data availability and quality should be carried out.

Continuing the example of reduction in passenger car travel, the data quality and availability assessment could look like this:

Box 3.4.2 – Table 4: Data quality assessment example

Reduction in passenger car travel	Reference scenario data		ICT solution scenario data	
	Availability	Quality	Availability	Quality
Distance travelled (km)	Yes	Poor – Does not cover full scope of assessment	Yes	Poor – Does not cover full scope of assessment
Vehicle type	Yes	Moderate – Records of vehicle types are manual and therefore inconsistent	Yes	Moderate – Records of vehicle types are manual and therefore inconsistent
Fuel type	Yes	Excellent – Expenses system data	Yes	Excellent – Expenses system data
Emissions per km (kgCO <sub>2</sub> e/km)	Yes	Good	Yes	Good
Fuel (litres) used by passenger cars	No	N/A	Yes	Excellent
Emissions per litre (kgCO <sub>2</sub> e/km)	Yes	Excellent	Yes	Excellent

### Requirement 3.4.2.2 (B)

The quality of the data can be reviewed according to the criteria in Table 5. In addition, the following guidance from the ITU should be used to select preferred data sources:

“In general, data used should reduce bias and uncertainty as far as practicable by using the best quality data achievable. Also data that is more specific with respect to time, geography and technology takes precedence over data which is less specific. Consequently, primary data is generally preferred to secondary data.” (ITU, 2022)

Primary data is typically considered to be better than secondary data, however, this should not be assumed. The data quality assessment should be applied consistently for primary data and secondary data, and, in some situations, secondary data may score more highly. For example, primary data from surveys may score poorly on representativeness if the survey sample was small compared to the total survey population when compared to secondary data of the same population (e.g. a national data source).



Table 5: Data Quality Review Criteria

Quality Criteria	Description	Considerations	Assessment
<b>Activity representativeness</b>	The degree to which the data set reflects the actual activity in the reference and solution scenarios	Is activity data collected from the actual process, or is it proxy (e.g. alternative similar process)? Are emission factors used specific to the activity, generic to the activity type, or using a proxy (e.g. spend based)? Is the data measured or assessed (e.g. survey data)? If assessed, do the questions accurately represent the activity?	Poor = Proxy activity Fair = Different generic activity type Good = Same generic activity type Very good = Specific activity type
<b>Temporal representativeness</b>	The degree to which the data set reflects the actual time (e.g., year) or age of the activity.	Activity data and emission factors used should be from the most relevant time period to the activity period.	Poor = Not a relevant time period Fair = Sample of relevant time period for less than 50% of time period Good = Sample of relevant time period for more than 50% of time period Very good = Covers entire relevant time period
<b>Geographical representativeness</b>	The degree to which the data set reflects the actual geographic location of the activity (e.g., country or site)	Activity data and emission factors used should be from the most relevant time period to the geographic location.	Poor = Not a relevant geography Fair = Sample of relevant geography for less than 50% of geography Good = Sample of relevant geography for more than 50% of geography Very good = Covers all of the relevant geography
<b>Completeness</b>	The degree to which the data is statistically representative of the relevant activity. Completeness includes the percentage of locations for which data is available and used out of the total number that relate to a specific activity. Completeness also addresses seasonal and other normal fluctuations in data.	Is the full dataset used or has it been sampled? If sampled, how statistically significant is it? Is the data measured or assessed (e.g. survey data)? If assessed, is the group representative? Does the data provide full coverage of the activity (e.g. full life cycle emission factors)?	Poor = Small sample / Incomplete coverage / data gaps filled with assumptions not backed by data Fair = Small sample / Incomplete coverage, use of reasonable, data backed assumptions to fill data gaps Good = Significant sample / coverage Very good = Full dataset
<b>Reliability</b>	The degree to which the sources, data collection methods and verification procedures used to obtain the data are dependable.	Is the data from publicly available & trustworthy sources (e.g. national or industry body emission factors)? If survey data is used, how much estimation is required to answer the question (e.g. general questions on behaviour/long periods of time or specific behaviour and occasions? Customer survey data can have limited reliability and suitable secondary data might be more reliable.	Poor = Secondary data that is not publicly available / from a reliable source Fair = Secondary data and proxies that are justified by strong evidence/reliable sources Good = Publicly available with transparent high-quality methods / Primary survey data with high-quality methods Very good = Primary measured data / Publicly available from an internationally renowned source

Adapted from GHGP Value Chain Accounting Standard and L1410

## 3.4.3. First Order Effects

### Requirements

- (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.
- (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.
- (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.

### Guidance

#### Requirement 3.4.3 (A)

The method used for calculating first order effects should be related to their materiality:

- Specific LCA carried out on the full solution life cycle according to an existing LCA standard (further details below) – this is recommended where full life cycle emissions are greater than 30% of the total net carbon impact per functional unit



- Light LCA based on material life cycle components that are estimated to comprise a minimum of 75% of the full ICT solution life cycle footprint. This can be used where total first order effects are estimated to be less than or equal to 30% of the total net carbon impact per functional unit. The light LCA can be calculated with the following methods.
  - Specific LCA on selected components of the solution. Use-phase calculations are likely to be able to employ specific LCA methods as operational data of the solution is likely to be available. This method should be employed where data is available.
  - Simplified LCA approaches as defined in the ICT Sector Guidance for the GHG Protocol Product Standard<sup>16</sup>: Component characterisation, Hardware parameterisation, Life cycle stage ratio profiling. The methodology document should contain a description of the approach used and explanations of any assumptions.
  - Proxy LCA data from similar products. The methodology document should contain a justification of similarity of the selected proxy.
  - An EEIO approach can be used where data is unavailable. This may be particularly relevant for embodied emissions calculations and end-of-life.

Where a specific LCA is being carried out for the solution or components of the solution the first order effects should be calculated according to an existing LCA standard including but not limited to,

- Greenhouse Gas Protocol Product Life Cycle Accounting Reporting Standard
- ITU-T L.1410 – Methodology for environmental life cycle assessments of information and communication of technology goods, networks and services
- PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services
- ISO 14067: 2018 Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification
- ISO 14044:2006 Environmental management – Life cycle assessment

### **Requirement 3.4.3 (B)**

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<sup>16</sup> Carbon Trust, 2017. ICT Sector Guidance built on the GHG Protocol Product Life Cycle Accounting and Reporting Standard



As a general principle, cut-offs shall be avoided to the extent possible, and it is preferred that the methods listed above are applied instead. Cut-off is based on the relative impact of the GHG emissions, however, it is often not practical to estimate this due to a lack of GHG emissions data for the activity. The estimated relative magnitude (section 3.4.1) should first be considered if there is a basis for exclusion. If the effect is likely to have a small impact determined by the estimated relative magnitude, the cut-off justification is recommended to consider the quantities of alternative physical (weight) and economic (value) parameters necessary to exceed 5% of the total net carbon impact or net carbon impact per functional unit (or the cut-off percentage defined in the relevant LCA standard) as a justification for cut-off. If cut-off is performed, the requirements and guidance in an existing LCA standard listed should be applied.

### Requirement 3.4.3 (D)(E)

First order effects need to combine the GHG impacts of embodied and end-of-life emissions that occur at the beginning and end of the solution lifetime along with the use-phase emissions that occur during the solution lifetime. Assessments of a solution (ex-post or ex-ante) have a selected time period for the assessment, that may not equal the full lifetime of the solution, therefore, the life cycle impacts need to be allocated. Allocation is carried out according to the defined functional unit. For example, if the functional unit is one day with a solution lifetime of one year, the allocation is 1/365 for the embodied and end-of-life emissions. Use-phase emissions are calculated for each day the solution is in use. Calculate the first order effects for the functional unit according to the following approach:

$$\sum 1st\ Order\ Effects = \left( \frac{\sum Embodied\ Emissions + \sum End\ of\ Life\ Emissions}{Functional\ Unit} \right) + \sum Use\ Phase\ Emissions_{Functional\ Unit}$$

The assessor shall ensure that GHG impacts for all first order effects that are not excluded from the assessment are calculated. The total effect will be calculated relative to the defined functional unit.

### 3.4.4. Second Order Effects

#### Requirements

- (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.

(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.

(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.

## Guidance

### 3.4.4.1. Second Order Effect Calculation Approaches

#### Requirement 3.4.4 (A)

This section of the methodology will consider the different calculation approaches that can be adopted as a consequence of the data availability for the reference and ICT solution scenario as determined under section 3.4.2. The approaches are provided as a general guide for assessors to consider how to setup the net impact calculation for second order effects, in practice, assessors may find that the calculations do not precisely match the approaches below.

Table 6: Net Carbon Impact Calculation Approaches

#	Reference scenario	ICT solution scenario	Net carbon impact calculation approach
1	Primary data (Different implementation or time period)	Primary data	GHG impact under reference scenario – GHG impact under ICT solution scenario <i>Adjust scenarios for equivalence for time / implementation differences</i>
2	Secondary data	Primary data	$(\text{Primary data} / (1 - \% \text{ change})) - \text{Primary data}$
3	Primary data	Secondary data	$\text{Primary data} - (\text{Primary data} * \% \text{ change})$
4	Secondary data	Secondary data	Estimate primary data for reference using secondary sources/assumptions Consider requirement (G)

## Approach 1: Primary data for both reference & ICT solution scenario

Typically, the most accurate method for calculating the impact of a second order effect is to collect primary data for both the reference and ICT solution scenarios. When this approach is adopted, the calculation approach assesses the difference between the two scenarios. Even when primary data is available for both the reference and ICT solution scenarios, some assumptions or transformations will be required to ensure equivalence between the scenarios. While primary data is typically considered to be better than secondary data, the data quality assessment should be used to decide if primary data in approach 1 is preferable to secondary data using other approaches.

### Comparison with a control group/situation

Primary data can be collected for the reference scenario as a control group or situation. Data may be collected before and after a solution is implemented or from a similar system acting as the control to assess the resulting net carbon impact. As the data has either been collected at different times or from different sources it is possible that the two datasets are not equivalent if implementation parameters influencing the system have changed

The assessment needs to consider what parameters in each scenario could be affected by the different conditions. If the implementation parameters are deemed to have changed then the assessor should consider how to recalculate to reflect the different conditions or if reasonable assumptions can be made to justify equivalence, see example Box 3.4.3. Data collected and averaged over a long time period can reduce variability between scenarios to support an assumption of equivalence between them. Any assumptions and/or justifications made should be documented. In cases where equivalence can't be established a different calculation approach from Table 6 should be adopted.

## Box 3.4.3 – Examples of control group differences

A building management solution (BMS) is implemented with a second order effect of the solution to reduce the total energy consumption of the building. Energy consumption data has been collected for the same building in different time periods before and after the BMS was implemented. As the energy consumption of the building will vary according to the time of year and year-on-year depending on the external environment (such as temperatures, sunlight, etc.), it is important to consider how the different conditions between the two time periods impacts the energy consumption in the reference and ICT solution scenarios. For example, a lower average temperature in one time period may cause higher energy consumption for building heating.

Similarly, if the control group for a production line monitoring solution was a similar production line without the solution, the differences of the similar production line would need to be considered.

## Approach 2: Primary data for the ICT solution scenario

This approach is suitable when primary data is not available for the reference scenario. In this approach, the assessment can either:

- Use secondary data from other existing implementations to estimate the 2nd order effect relative to the primary data collected for the ICT solution scenario.
- Estimate the activity under the reference scenario.

The first method above uses primary data for the ICT solution scenario and secondary data from existing implementations of the effects being assessed. It is important that the implementation context of the existing implementations is similar to the implementation context of the assessment to ensure that the secondary data is applicable. This approach uses the following equation (see example Box 3.4.4):

$$\text{Impact of 2nd order effect} = \left( \frac{\text{Enabled scenario data}}{(1 - \% \text{ change})} \right) - \text{Enabled scenario data}$$

## Box 3.4.4 – Example use of other implementations to estimate the 2nd order effect

A fleet management solution where primary data is available for the total fuel consumption of the fleet over a year with the fleet management solution in place, but no data was collated for the same fleet prior to the implementation of ICT solution. The reduction in fuel consumption due to the implementation of the fleet management solution has been assessed by existing studies, to ascertain a percentage change. Thus, the following equation can be used to assess the second order effect for the fleet being assessed:

$$\begin{aligned} & \text{Avoided fuel consumption (litres)} \\ &= \left( \frac{\text{Enabled fuel consumption (litres)}}{(1 - \% \text{ change})} \right) \\ & - \text{Enabled fuel consumption (litres)} \end{aligned}$$

Under the second method above, suitable secondary data is selected to estimate the reference activity of the reference scenario. Consider an e-commerce solution where online shopping substitutes travel to the retail premises. The solution owner/operator will collect data on the use of their service, however, they do not know how the customer would have travelled had they not used the solution. If the solution users are the general public, sources such as national statistics may provide suitable secondary data that defines the reference activity of the users in the relevant implementation context (see example Box 3.4.5). When estimating the quantity of the reference activity the assessment must exclude rebound usages of the solution (requirement (D)) so that the second order effects are not overestimated, see section 3.4.4.2. In the event that suitable secondary data cannot be identified for the reference activities a different approach from Table 6 should be adopted.

## Box 3.4.5 – Example estimation of activity under the reference scenario

An e-commerce solution estimates the substituted travel activity in the reference scenario with the following equation:

*Reduced customer travel*

$$\begin{aligned} &= \text{Number of trips avoided} \times \text{Avg. distance travelled per return journey} \\ &\times ((\% \text{ PasCar trips} \times \text{PasCar emission intensity}) \\ &+ (\% \text{ Rail trips} \times \text{Rail emission intensity})) \end{aligned}$$

Secondary data is identified for the emissions intensities of reference activities, the percentages of each travel mode (passenger car vs. rail trips), and the average distance travelled to the retail premises. The number of trips avoided must be estimated by consideration of the available primary data for the ICT solution scenario. In this example, the number of online purchases in the ICT solution scenario is known and can be used to estimate the reference activity, but it is critical that rebound usages of the solution are not included in the assessment, see section 3.4.4.2.

## Approach 3: Primary data for the reference scenario

This approach is for calculations where there is no data available for the impact of the solution in the ICT solution scenario. Primary data is available to quantify the effect of the reference activity to be modified by the solution and suitable secondary data available for the solution is used to assess the GHG impact of the ICT solution scenario. This approach is most suitable for ex-ante calculations where the solution implementation hasn't occurred and an estimate of the impact is required, or as a method to extrapolate the impact of the solution to other comparable implementation contexts where data has not been collected.

As with approach 2, the assessment can either:

- Use secondary data from other existing implementations to estimate the 2nd order effect relative to the primary data collected for the reference scenario.
- Estimate the activity under the ICT solution scenario.

The first method above uses primary data for the reference scenario and results from existing implementations of the effects being assessed. It is important that the implementation context of the existing implementations is similar to the implementation context of the assessment to ensure that the secondary data is applicable. This approach uses the following equation (see example Box 3.4.6):

*Impact of 2nd order effect*

$$= \text{Reference scenario data} - (\text{Reference scenario data} \times \% \text{ change})$$



## Box 3.4.6 – Example use of other implementations to estimate the 2nd order effect

A fleet management solution where primary data is available for the total fuel usage of the fleet over a year without data collected after implementation of the ICT solution. Existing studies of the fuel savings can be used to assess the second order effect for the fleet being assessed:

$$\text{Fuel reduction (litres)} = \text{Fuel consumption (litres)} \times \% \text{ change}$$

The second method requires that primary data of the solution implementation has been collected from other similar implementations of the solution or from implementations of other similar solutions to be used as secondary data in the assessment. If the assessment is being undertaken by a user of the solution, it may be necessary to partner with an organisation involved in the solution development, operation, implementation, etc. to be able to obtain the appropriate data.

The assessor should consider the applicability of the secondary data with an understanding of the full calculation parameters behind the percentage change data. As with any applications of secondary data in calculations, the assessor must apply judgement to determine if data available from other solution implementations is suitable for the boundary conditions and implementation context(s) and consider the relevance of the sample behind the data and effects such as early adopter bias. In the event that a suitable justification of the secondary data cannot be made for the solution implementation, a different approach from Table 6 should be adopted. Any assumptions and/or justifications made shall be documented. See example Box 3.4.7.

## Box 3.4.7 – Example estimation of activity under the ICT solution scenario

A water management solution is implemented in a small office-based business. Primary data is available for the reference scenario and secondary data from other implementations of the solution and is used to estimate the percentage of water saving. The secondary data sources include manufacturing organisations that use significant quantities of water in the production process. Therefore, these implementations are not representative of this implementation and should be excluded.

## Approach 4: No primary data for either scenario

Where net carbon impact assessments are to be used for public claims of a solutions' impact (including annual reporting) this approach should not be used. Approaches 1-3 from Table 6 should be used as they necessitate the use of some primary data for the solution (Requirement 3.4.4 (G)). Where no primary data is available for either scenario, the guidance

provided in approaches 2 and 3 which use secondary data to estimate the net carbon impact should be used to estimate both scenarios.

## **Requirement 3.4.4 (B)**

As stated for first order effects, cut-offs of second order effects shall be avoided to the extent possible, and it is preferred that proxies or estimation methods are applied instead. Cut-off is based on the relative impact of the GHG emissions compared to the total net impact, however, it is often not practical to estimate this due to a lack of GHG emissions data for the activity. The estimated relative magnitude (section 3.4.1) should first be considered if there is a basis for exclusion. If the effect is likely to have a small impact determined by the estimated relative magnitude, the cut-off justification is recommended to consider the quantities of alternative physical (weight) and economic (value) parameters necessary to exceed 5% threshold as a justification for cut-off.

## **Requirement 3.4.4 (C)**

The GHG impact of each second order effect shall be quantified according to a full life cycle perspective. Each second order effect is either a modification of a reference scenario activity, a substitution of a reference scenario activity, or an additional activity in the ICT scenario. All upstream and downstream impacts of the effect must be considered to ensure the full life cycle impact resulting from the effect is assessed. For example, a reduction in fuel consumption must include the reduced emissions from extraction, processing, transport, and storage (well-to-tank emissions), as well as the reduced emissions from combustion.

### **3.4.4.2. Exclusion of Rebound Usages**

## **Requirement 3.4.4 (D)**

Positive second order effects of the solution implementation must only be calculated for modified reference activities and shall not include additional rebound usages as this will overestimate the positive impact. Rebound usages are the increased use of the system as a result of rebound effects from the solution implementation, therefore, it is incorrect to calculate any positive impacts from use that would not have occurred in the reference scenario (*Figure 4* illustrates this issue in section 3.4.5).

When primary data is collected for the ICT solution scenario and used to estimate the reference scenario (approach 2) the measured activity may include rebound usages of the solution and may lead to over-estimation. For example, measured data on the number of sales on the e-commerce solution in example Box 3.4.5 would include an increased number of purchases as a result of increased convenience (rebound effect). Therefore, the assessment of the second order effect cannot assume that the number of avoided trips to the retail premises is equal to the number of purchases on the platform as the additional rebound trips would not have occurred. Therefore, if rebound effects have been identified,

equivalence between the activity in the reference and ICT solution scenarios cannot be assumed. The assessor should consider other relevant data sources that could indicate a change in the level of activity between the scenarios, see example Box 3.4.8. Rebound effects are discussed further in section 3.4.5.

### Box 3.4.8 – E-commerce example contd.

Using the total number of sales made before the solution implementation eliminates additional rebound orders due to the solution implementation, however, it would also eliminate any growth of the organisation that would have happened without the solution. Therefore, the increase in sales that would have occurred can be considered by taking the average growth of the organisation over the previous 3-year period. The resulting equation could be:

*Reduced customer travel*

$$\begin{aligned} &= (\text{Total sales before implementation} \times \text{avg. growth over prior 3years}) \\ &\times \text{Avg. distance travelled per return journey} \\ &\times ((\% \text{ PasCar} \times \text{PasCar emission intensity}) \\ &+ (\% \text{ Rail} \times \text{Rail emission intensity})) \end{aligned}$$

### 3.4.4.3. Exclusion of Existing Occurrence of the Second Order Effect

#### Requirement 3.4.4 (E)

There may be situations where an ICT solution is implemented, and the second order effect generated is additional to the second order effect generated from other similar solutions. The ICT solution being assessed should not include the effects of other similar solutions. By adopting this approach, the net carbon impact calculation avoids over-estimating the impact of the solution by excluding activity that would have occurred in the reference scenario.

### Box 3.4.9 – Example exclusion of existing occurrence of second order effect

A smart electric vehicle (EV) charging solution implementation substitutes the consumption of fossil fuels with renewable electricity. When assessing the substitution, the existing use of EV's and charging infrastructure in the region should be considered as this was present before this implementation. Therefore, if EV's represent 5% of vehicles on the road in the reference scenario, the assessment should consider that 95% of the renewable electricity provided by the solution is substituting fossil fuels and 5% is providing energy to vehicles already present in the transport system enabled by other electric vehicle charging systems.

## 3.4.5. Higher Order Effects

Assessment of the higher order effects resulting from the solution implementation is critical to a net carbon impact assessment as the assessment is likely to be used as a basis to make informed decisions. Quantitative assessment of the first and second order effects alone does not provide a robust basis and must be supported by an assessment of higher order effects for due consideration by decision-makers. The impact of higher order effects (positive or negative) can be significant and have the potential to negate positive impacts of the solution. Due to the indirect nature of these effects, they can be challenging to assess quantitatively. This methodology requires a qualitative assessment at a minimum, however, quantitative assessment should occur wherever this is feasible. While quantification for first and second order effects can be very precise, this should not misguide assessors or decision-makers that the net impact is also precise if higher order effects are identified and not quantified. Due consideration must be given to the qualitative assessment of these alongside the quantified result.

### Requirements

- (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.<sup>17</sup>
- (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, see section 3.8.
- (C) The GHG impact of higher order effects shall be calculated with a life cycle perspective, where it is feasible.

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<sup>17</sup> ITU-T L.1480 has a tiered assessment approach where for higher order effects, tier 3 recommends identification not assessment, tier 2 demands identification, and tier 1 demands assessment by quantitative means if possible, otherwise by qualitative means. The EGDC methodology aligns to Tier 1 only.

- (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.

## Guidance

### 3.4.5.1. Qualitative Assessment

#### Requirement 3.4.5 (A)

The assessment should describe how the higher order effect is generated by consideration of the consequence tree. This provides the assessor with an understanding of the scenario leading to the effect necessary to analyse it. Any contextual factors that are associated to the identified higher order effect should be identified and, if possible, analysed to identify measures to suppress obstacles and magnify incentives. These are useful to consider when considering how to effectively deploy the solution.

The timeframe of the effect helps the assessor determine if the data collected of the solution implementation is likely to be affected by higher order effects. Effects with a short timeframe, such as immediate rebound effects, may be captured within the measured data and actions would need to be taken to ensure that the first and second order effects have been calculated accurately. An example of this is additional participation in an online meeting as opposed to a face-to-face meeting, the additional attendees enabled by the online nature of the meeting would be present in the data collected.

Qualitatively assessing the expected magnitude of higher order effects can be in the form of low, medium, and high in relation to the total net carbon impact of the solution, but this will be dependent on the knowledge about the effect and the availability of the data. Other descriptions of the likely magnitude may also be suitable. Where knowledge or data of the effect is limited, the expected magnitude can be considered by adopting a sensitivity analysis approach. Consider how much of the higher order effect would you need to exceed 50% of the total net impact. Then, using assumptions and estimations as necessary, back calculate what the values of parameters associated with the higher order effect would be necessary to be to meet the 50% impact and determine if these values are likely or reasonable.

It is important to assess the likelihood of the effect occurring as part of the consideration of its overall impact, as the combination of both its magnitude and likelihood is necessary to estimate the overall significance of the effect. The consequence tree is useful to assess the likelihood of each of the linkages between effects to determine an overall likelihood. Typically, longer consequence chains have less likelihood of occurrence.

The relationship to the solution is an assessment of the evidence that supports the linkage of the effects in the consequence tree, and it is partially linked to the likelihood of

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occurrence. Assessment of higher order effects identification is about identifying risks which may occur as a result of the solution implementation even when a relationship has not been proven. If a strong relationship is proven it may support a high likelihood of occurrence, whereas a weak relationship may suggest a lower likelihood of occurrence.

### 3.4.5.2. Quantitative Assessment

#### Requirement 3.4.5 (B)

The qualitative assessment provides an analysis of the significance for all identified higher order effects and can be used to justify the exclusion of the higher order effects where they are deemed insignificant. Significant higher order effects should be estimated quantitatively, where this is possible. While quantification of higher order effects may be challenging in some circumstances, they can and should be quantified. Higher order effects can occur immediately or in the short-term and these are typically easier to quantify as the effect and relationship with the ICT solution can be more clearly seen. The effect may also be evident in the collected data, as discussed in section 3.4.4.2. Medium- to long-term effects may be harder to study, however, they may be estimated through the use of secondary data and research into the effect where available.

#### Consideration of rebound effects

Rebound effects result in an increased level of activity in the ICT solution scenario as a result of the increased efficiency generated by the ICT solution (i.e. cheaper or otherwise more convenient). If these rebound usages are not identified, the assessment will likely result in overestimation of the second order effect as demonstrated by Figure 4 below.

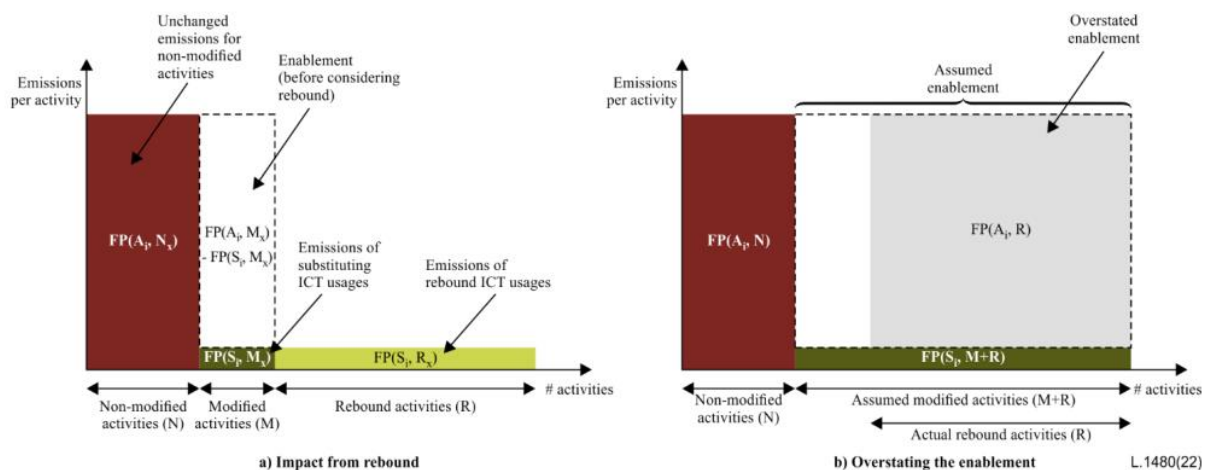


Figure 4: Schematic illustration of (a) the impact from rebound activities, and (b) an often-encountered error in existing assessments. Sourced from ITU-T L.1480.

Figure 4 (b) shows the overstated second order effect (termed “Overstated enablement”) if the rebound activities are included with the modified reference activities. Therefore, it is



important that the assessment excludes rebound usages when calculating positive second order effects but includes them when calculating the first order effects or negative second order effects as rebound activities leads to increased quantity/use of the ICT solution.

## **Approaches for Estimation of Rebound Activity**

Estimating rebound activity requires consideration of suitable proxy data sources or secondary data sources relevant to the reference activity that could indicate an absolute activity quantity or change in the level of activity between the scenarios. The assessor will need to consider suitable data sources that can indicate levels of activity and it may be required to combine several data sources. Assessors should consider:

- Measured activity data for the ICT solution scenario may capture rebound effects.
- Proxy data relevant to the activity for the entity where the solution is being implemented (e.g. an organisation or region). For example, if considering travel activity, a reference amount of travel per employee could be used to establish travel activity for the different scenarios.
- Geographically relevant secondary data of the same activity, this could be sourced from national or regional databases, or organisations of similar type.
- Research of the rebound effect relationship. Research of the effect could be undertaken by one of the organisations involved in the solution development or by an academic institution.
- Previous behaviour and preferences.

Where the second order effect is calculated using primary data for the activity in the ICT solution scenario, rebound effects that occur immediately or in a short timeframe may be captured within the measured activity, e.g. an online meeting can allow for more attendees to the meeting than an in-person event, the additional attendees are rebound usages. As discussed in requirement 3.4.4 (D), additional rebound usages may need to be excluded from the second order effect calculation depending on the approach used. In all cases additional rebound usages should be included in the first order effects calculation.

Where the activity in the ICT solution scenario is estimated using secondary data, the assessor must consider if the secondary data considered rebound effects and excluded additional rebound from the secondary data. If the assessor has identified rebound effects that are not considered in the secondary data calculation, then these rebound effects should be assessed separately.

When the level of activity in the ICT solution scenario is unknown and assumed to be constant with the reference scenario, e.g. only the emissions intensity of the activity has changed, the potential impact of rebound effects have not been considered. As rebound effects will increase the quantity of the activity in the ICT solution scenario, any negative

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impacts resulting from use of the solution will be increased. Therefore, calculations including these impacts may need to be updated to consider the increased activity quantity.

Rebound effects can also result in increased use of other resources, products, services, or activities that are not part of the ICT solution which should also be considered<sup>18</sup>. Typical examples of this are time or financial gains provided to users of the solution that enables increased activity elsewhere with an associated GHG impact.

Estimation of these effects is likely to require use of secondary data or proxy data to estimate the alternate activity quantity and emissions intensity. ITU-T L.1480 Appendix IV provides guidance for quantifying the GHG impact as a result of financial effects generated by an ICT solution.

## 3.5. Net Carbon Impact Calculation

### Requirements

- (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.
- (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.

### Guidance

### 3.5.1. Total Net Carbon Impact within the Time Boundary

#### Requirement 3.5 (A)

Following calculation of the GHG impacts resulting from the first, second, and higher order effects the net carbon impact of the ICT solution can be calculated. The assessor must ensure that all effects determined within the boundary and not excluded from the assessment have been included. The net calculation sums the GHG impacts of all effects according to the functional unit selected. Therefore, the net carbon impact for the functional unit is:

$$Net\ Carbon\ Impact_{FU} = \sum 1st\ Order\ Effects + \sum 2nd\ Order\ Effects + \sum Higher\ Order\ Effects$$

<sup>18</sup> Referred to as indirect rebound in ITU-T L.1480

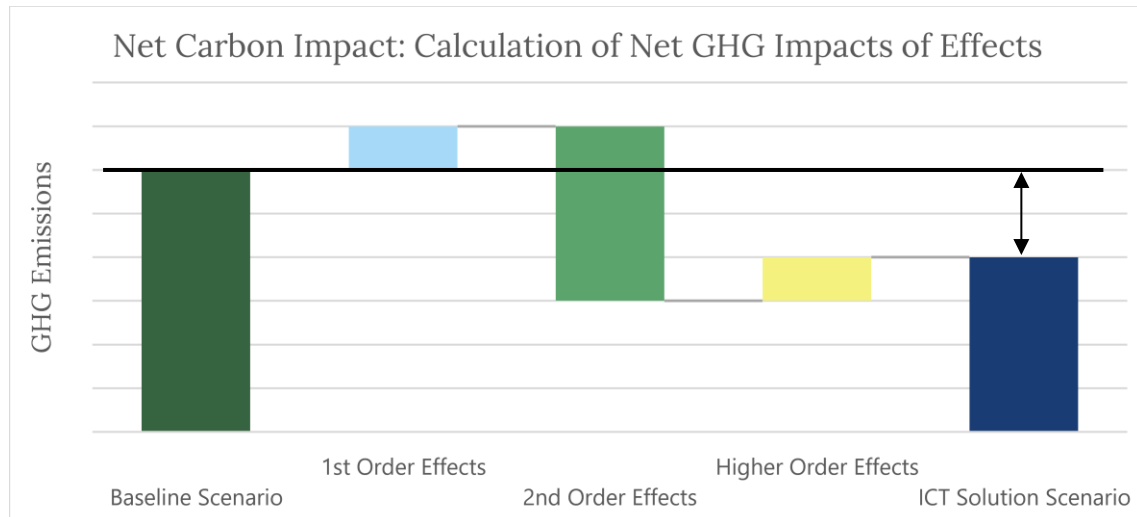


Figure 5: Net Carbon Impact Calculation

The arrow in Figure 5 shows the net carbon impact resulting from the sum of all the effects. As per common understanding GHG emissions are positive values and reductions are negative. This should not be confused with terminology of positive GHG impacts, that represent a reduction in emissions from the reference to the ICT solution scenario.

The net carbon impact of an ICT solution is calculated in relation to the functional unit and can be used to assess the total net carbon impact of the ICT solution over a period of time in use as defined by the time boundary of the assessment. The assessment will have been defined as either an ex-post or ex-ante assessment (section 3.2.4) and the net carbon impact needs to be calculated accordingly.

To calculate the total net carbon impact of the ICT solution within the time boundary the assessor needs to determine the relevant number of functional units for the selected time period. The calculation of this is determined by the functional unit selected, for example, if the functional unit was a per single use of the solution, the total uses of the solution by a typical user in the time period needs to be calculated.

$$Total\ NCIA = Functional\ Units \times Net\ Carbon\ Impact_{FU}$$

### 3.5.2. Significant changes to GHG impacts during the Time Period

#### Requirement 3.5 (B)

Changes that occur during the time period of the assessment that would significantly affect the calculated GHG impacts of the first, second, or higher order effects shall be included in the assessment. Changes may occur to the implementation context for the solution, the reference scenario, or the effect of the solution itself. This is particularly relevant for ex-

ante assessments that include assumptions about the future performance of the solution, the implementation context it operates in, and the reference scenario.

The implementation context may experience changes that affect the emissions of the system being assessed; electricity emissions factors are a typical example, as these change annually. The reference scenario can change over the lifetime of the solution implementation, where this is identified to occur during the time boundary of the assessment, the assessment should be split to consider the different reference scenarios at different time periods within the boundary where this is possible to do so, e.g. reference A in years 1-3 and reference B in years 4-8. The performance of the solution and resulting GHG impacts may also change over time such as diminishing returns of the second order effects. For example, an AI solution that learns user behaviour to efficiently utilise resources may generate significant savings at the beginning of the deployment, but these may diminish over time.

To assess changes to the net carbon impacts of ICT solutions, the key parameters that have/will vary need to be identified (e.g. electricity grid emission factors). The list of identified parameters will include inputs included in the net carbon impact assessment that can be adjusted to quantitatively determine the changes in the net carbon impact of the ICT solution, as well as factors external to the calculation (e.g. policy changes) that can only be qualitatively assessed.

It is recommended to outline all parameters that have been quantitatively adjusted in the calculation and the resulting impact on the net carbon assessment. It is also recommended to outline how and why they have been adjusted. Any factors that cannot be adjusted (e.g. an indeterminable change to the reference scenario in the future) should be listed and their likely impact explained.

## 3.6. Uncertainty and Sensitivity Analysis

### Requirements

- (A) A sensitivity analysis should be carried out for all key parameters as part of the net carbon impact assessment.
- (B) A net carbon impact assessment should include an uncertainty analysis of the results.

### Guidance

#### Requirement 3.6 (A)

The sensitivity of the results in relation to all key inputs of the net carbon impact assessment should be assessed. This includes any inputs that were used for the calculation of the included first, second, and higher order effects. Particular attention should be given

to situations where multiple reference scenarios are used. In these situations, analysis of the different combinations and weightings of the reference scenarios should be considered.

The process for the sensitivity analysis will depend on the inputs but could be based on:

- An existing uncertainty analysis of the inputs, e.g., certain statistics or emission factors may already be communicated with an uncertainty range that could be used for the sensitivity analysis.
- Available secondary sources for the same input, e.g., if using a database for a specific input, other databases could be reviewed for the same input to determine an uncertainty range.
- Worst case scenario analysis, e.g. assessing how much an input would need to vary by to significantly change the results.
- Reasonable variation parameters (x0.5 and x2, or x0,1 and x10) are commonly applied if more specific information is missing. If varying a parameter in this way does not result in a significant change, the assessor need not to focus on specific evaluation of that parameter.

The data quality for each input should be taken into account when deciding the approach for each input.

### **Requirement 3.6 (B)**

The sensitivity analysis of all key inputs should be combined to create a lower and higher uncertainty range for each effect included in the net carbon impact assessment, as well as giving an overall uncertainty range for the net carbon impact of the ICT solution. It should be noted that this only calculates the combined uncertainty of the assessed parameters and not the total uncertainty of the result which may include other unquantified effects (such as higher order effects). Further guidance on quantitatively assessing uncertainty is provided by the Greenhouse Gas Protocol<sup>19</sup>.

Effects that have been excluded since they cannot be quantified or deemed insignificant would not be included in the sensitivity analysis but should always be transparently reported as exclusions (section 5).

## **3.7. Critical Review**

Alignment with this methodology is the sole responsibility of the reporting organisation. To ensure alignment, a critical review of the assessment should be carried out at least by an independent party internal to the organisation. Depending on the intended use of the

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<sup>19</sup> Quantitative Uncertainty Guidance – [Calculation Tools and Guidance | GHG Protocol](#)

assessment, it may be recommended or required for critical review by an independent third party, or through a scientific peer review. ITU-T L.1480 provides questions that can be used to evaluate the applied method in section 10.4.1.

### 3.8. Recalculation

Net carbon impact assessments can include many assumptions, estimation methods, or data within the calculation that are liable to become outdated over time. If this happens, it may be necessary to update the net carbon impact assessment.

#### Requirements

- (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.

#### Guidance

#### Requirements 3.8 (A)(B)

Depending on the initial calculation approach used and the changes required, it may be possible to update only certain parts of the net carbon impact assessment. This may be especially the case for assessment parameters. For example, the carbon intensity of the grid will be a key assessment parameter for ICT solutions that enable electricity savings and may need to be updated annually to align with the changing intensity of the grid.

However, certain changes, such as a change in the reference scenario, may make it impossible to adjust the net carbon impact assessment. In this case, a new net carbon impact assessment should be carried out.

Any exclusions from the assessment, in particular higher order effects, should be reviewed and considered if continued exclusion is acceptable. Organisations should look to continuously improve assessments and reduce exclusions of significant higher order effects over time.

## 3.9. Consideration of Other Environmental Impacts

### 3.9.1. Do No Significant Harm

The focus on the net carbon impact assessment is the effect on climate change of GHG emissions. However, it is also important to consider other environmental impacts of an ICT solution. This methodology aligns to the environmental objectives set out in the EU Taxonomy and provides a qualitative assessment that organisations should complete to determine that no significant harm is done to these objectives. Demonstrating that a solution does no significant harm to these objectives is a requirement for being able to claim a contribution for an ICT solution (see Section Claiming Net Carbon Impacts as an Organisation).

The EU Taxonomy provides a framework for net environmental impact covering six environmental objectives (European Commission, 2021):

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 guidelines provided by the EU taxonomy to assess the do no significant harm criteria for data-driven solutions for GHG emissions reductions contribution to climate mitigation could be used.

## 4. Using Results in Other Implementation Contexts

The net carbon impact assessment of a solution is unique to the defined assessment and assessment boundary, including the implementation context. However, assessors may wish to calculate the impact of a solution in multiple implementation contexts to answer questions such as,

- What is the estimated total impact of deployed solutions at different scales such as all deployments in a city or region?<sup>20</sup>
- What is the estimated impact of the solution in possible future deployments?

While it would be preferable to carry out a new net carbon impact assessment for each implementation context, this is not always feasible due to lack of data and resources. Instead, an existing net carbon impact assessment may be updated or extrapolated to assess the impact in other implementation contexts. This section provides guidance to assessors in how a net carbon impact assessment for a specific implementation context can be used to assess the net carbon impact in other implementation contexts.

### Requirements

- (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.

### Guidance

#### Requirement 4 (A)

Assessment of a new implementation context must consider the same ICT solution and functionality, as the use-case must be the same between the assessments. If the solution deployed in a new implementation context has different functionality from the original assessment, or the new deployment uses functionality that existed but was not utilised in the original assessment, then the ICT solution scenario is considered to have changed.

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<sup>20</sup> ITU-T L.1480 refers to assessments at different scales (section 12) providing examples of an organisational scale, city scale, country scale and worldwide. This methodology also considers that using the results in other implementation contexts may be useful for assessing a similar implementation context at the same scale.



Similarly, as the reference scenario is dependent on the implementation context, it is necessary to assess if the same reference scenario is valid in the new implementation context as applied to the original assessment. It is particularly important to assess if the ICT solution could be considered business-as-usual in the new implementation context when it wasn't in the original assessment. If this occurs the reference scenario is not the same and the original assessment results cannot be used. This is a common source of error that is amplified when extrapolating the results of one assessment across other implementation contexts.

For example, when a solution enabling homeworking is implemented in a rural location where there was previously no connectivity it can generate a net positive impact, however, the reference scenario and the results of the net carbon impact assessment would be different if the same solution was implemented in a developed urban setting with high access to connectivity where homeworking was considered business-as-usual. Extrapolating the results of the first assessment across the second implementation would not generate a valid assessment even when the assessment parameters are amended.

#### **Requirement 4 (B)**

When using the results of a net carbon impact assessment in a different implementation context, it is crucial to identify all of the conditions that are different between the two implementations. This could include, but is not limited to changes in:

- The geographical boundary resulting in changes to,
  - structural factors (e.g. changes to the electricity grid carbon intensity),
  - external environmental factors (e.g. changes to the ambient temperature).
- The type and age of assets involved or the system that the ICT solution is applied to (e.g. changes in the energy efficiency of a building).
- The contextual factors (e.g. policies or incentives).
- The user group(s) and behaviours.

Once identified, it should be assessed whether relevant parameters within the assessment can be adjusted. Adjustments to the parameters can be based on available statistics, surveys, other secondary data, or theoretical modelling, which allows for varying individual parameters while keeping all other parameters constant.

For example, if a smart meter solution that enables savings in electricity has been assessed in country A and the results are now being applied to country B, a key assessment parameter is the electricity grid carbon intensity, which can be easily adjusted by using different emission factors. The net carbon impact of the solution is also dependent on the user behaviours in response to the smart meter information which could differ between

country A and B. This cannot be modelled as a parameter and shall be further analysed according to Requirement 4 (C).

When using an assessment in other implementation contexts, assessors should repeat these steps in the analysis:

- Defining the assessment objective and boundary
- Estimating the relative magnitude of effects
- Data quality analysis
- Quantitative assessment of first, second, and higher order effects
- Qualitative review of identified higher order effects
- Net carbon impact calculation
- Uncertainty and sensitivity analysis
- Do no significant harm review

## Requirement 4 (C)

For parameters that cannot be adjusted, a qualitative assessment should be done to assess to what extent the difference in parameters would change the results of the net carbon impact assessment. A conservative approach should be used for the qualitative assessment, and if it is likely that a significant change to the outcome would occur or could overestimate a positive impact, then results of the original assessment should not be used to assess the new implementation context. The sensitivity analysis and estimation of relative magnitude of effects carried out as part of the net carbon impact assessment can be used to consider the significance of changes to elements of the assessment as assessors can use these to consider the potential magnitude of the effect.

Table 7: Example qualitative assessments for a smart meter solution and a fleet management solution

Parameter description	Change in new implementation context	Estimated magnitude of effect	Sensitivity of variation of parameter	Review
Percentage energy savings as a result of smart meter usage	Country B is culturally different to country A with low consideration of energy efficiency in residential settings.	The related second order effect is the primary source of GHG emissions reductions.	Variation of the parameter by +/-2% resulted in a change of net emissions by +/- 10%.	Parameter is significant and likely to reduce net positive impact. Original assessment should not be used unless a suitable

	Electricity costs are low due to subsidies.			replacement source can be found.
Fuel savings as a result of fleet management solution	Fleet B operates over longer distances than fleet A. Route optimisation is therefore likely to result in higher emissions savings.	The related second order effect is the primary source of GHG emissions reductions.	Variation of the parameter by +/-5% resulted in a change of net emissions by +/- 18%.	Parameter is significant but likely to increase net positive impact. Original assessment can be used without a replacement source as it will underestimate the impact.

## 5. Communicating and Documenting Outcomes from Net Carbon Impact Assessments of a Single ICT solution

Transparency of a net carbon impact assessment is vital for the credibility of the result or claim. Net carbon impact assessment results calculated according to this methodology require adequate communication and disclosure of the assessment. A net carbon impact assessment utilises specific assumptions, methods, and reference data and therefore the reported net carbon impact is specific to the solution and to the implementation context. These assessments are hypothetical in nature as they are based on likely counterfactual scenarios. Comparisons between solutions are unlikely to provide useful insight and it should be recognised that reported values have an inherent uncertainty which, if possible, should be quantified and reported.

### Requirements & Recommendations

The results of a net carbon impact assessment are only valid under the conditions of the study and the assessment of second order effects are always a hypothetical comparison of estimated impacts with a reference scenario. Organisations communicating results from a net carbon impact assessment of a single ICT solution shall 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 their 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.

### Guidance

#### Requirement 5 (A)(B)(C)(D)(E)

Table 8 provides guidance on the type of information that should be documented and disclosed alongside the total net carbon impact of an ICT solution.

Table 8: Example communications supporting a net carbon impact assessment

ICT Solution and assessment description	Organisational contribution
Description of the ICT solution, reference scenario, implementation context(s), etc.	Description of organisational contribution with A / B / C level classification highlighting that the claim is non-exclusive.
Quantified impacts (tCO <sub>2</sub> e)	Other identified impacts
Net carbon impact:	Description of identified higher order effects, their likelihood, magnitude, and any actions undertaken to mitigate their effect
First order effects:	
Second order effects:	Description of other environmental impacts and consideration of no significant harm
Higher order effects:	

## Recommendation 5 (F)(G)

Table 9 provides guidance on the type of information that should be documented and disclosed alongside the total net carbon impact of an ICT solution.

Table 9: Guidance for documentation and disclosure of the net carbon impact of an ICT solution

Assessment Definition	<ul style="list-style-type: none"> <li>Assessment aim / purpose</li> <li>ICT solution description, intended use, and intended effect(s) on GHG emissions</li> <li>Assessment perspective</li> <li>Solution boundary (i.e. components of the solution)</li> <li>Functional unit</li> <li>Geographic and time boundary</li> <li>Implementation context(s) and contextual factors</li> <li>Reference scenario description &amp; justification</li> </ul>
Effects of the solution	<ul style="list-style-type: none"> <li>First order effects identified classified as included or excluded</li> </ul>

	<ul style="list-style-type: none"> <li>• Second order effects identified classified as included or excluded</li> <li>• Higher order effects identified classified as included or excluded</li> <li>• Justification of any exclusions</li> <li>• Link between identified effects in a consequence tree</li> </ul>
Net Carbon Impact Assessment	<ul style="list-style-type: none"> <li>• First order effects: Calculation approach, data sources, assumptions</li> <li>• Second order effects: Calculation approach, data sources, assumptions</li> <li>• Higher order effects: Calculation approach, data sources, assumptions</li> <li>• Qualitative assessment of higher order effects</li> <li>• Data sources, data quality assessment, and efforts taken to improve data quality</li> </ul>
Multiple implementation contexts	<ul style="list-style-type: none"> <li>• A description of the method for any estimations undertaken</li> <li>• Summary of the qualitative review for parameters that could not be adjusted</li> </ul>
Results	<ul style="list-style-type: none"> <li>• Net carbon impact result per functional unit and/or total net carbon impact</li> <li>• Results disaggregated by first, second and higher order effects</li> <li>• Results from sensitivity and uncertainty analysis</li> </ul>
Additional information	<ul style="list-style-type: none"> <li>• Statement of qualitative impacts to other environmental objectives</li> </ul>
Critical Review	<ul style="list-style-type: none"> <li>• The review process, whether internal, third party or scientific peer review.</li> <li>• Third-party reviewers</li> <li>• Scientific reviews properly referenced to the publication</li> </ul>

## 6. Claiming Net Carbon Impacts as an Organisation

ICT solutions are composed of multiple components, both ICT and non-ICT. Often many different organisations are involved in the development, manufacture, and deployment of the ICT solution and the components comprising the solution. While assessments can focus solely on the solution and remain agnostic of the contributors, organisations may want to communicate their involvement with solutions. Therefore, this section provides guidance from an organisational perspective when it is suitable to claim a net carbon impact.

All components and infrastructure comprising a solution have a role in achieving its outcome and, when considering multiple organisations involved in the development, manufacture, and deployment of a solution, it is important to recognise contributions of those involved. Equally, any claims of contribution must be credible and inevitably a cut-off is required as to where a claim of contribution is valid, otherwise there is a risk of overstated claims and greenwashing. Therefore, this section establishes criteria to be met for claims to be made.

The criteria established in this section do not allow contribution claims to be made for any component that is not specialised for use in the ICT solution, this could include components such as off-shelf IoT sensors or packaged software. It is recognised that this cut-off excludes a significant number of ICT products and services that are typically not specialised for use by ICT solutions. This decision reflects the complexity in this area of ICT and the challenge with the attribution of benefits from a single solution to the typically large number of organisations involved with the development and deployment of ICT solutions. This exclusion is not intended to diminish the importance of these products and services which are often fundamental elements of ICT solutions. The continued development of non-specialised products and services is necessary to keep pace with technological advances and expansion is therefore pivotal for innovation in the ICT sector and plays a central role in delivering sustainable benefits from ICT solutions.

### 6.1 Contribution Criteria

#### Requirements

- (A) To enable a claim of contribution to an ICT solution the organisation's activity shall qualify as either,
- (i) the innovation of the end-to-end solution,
  - (ii) the development and/or integration of the end-to-end solution,
  - (iii) the deployment of the end-to-end solution where it can be demonstrated that the activities have led to an increase in deployment, or,
  - (iv) a provider of a component of the solution.



- (B) If the organisation's contribution qualifies as a provider of a component of the solution, the following additional criteria needs to be met:
- (i) The component that the organisation is contributing to the solution is not already a contributing component to the activities outlined under the reference scenario.
  - (ii) The component has an essential and substantial role in achieving identified second order or higher effects included in the net carbon impact assessment.
  - (iii) The component must be developed or modified to make it specialised for the ICT solution.
  - (iv) The organisation should be able to evidence that the component that the claim is being made for, is being implemented in the assessed ICT solution.

## Guidance

### Contribution Criteria (A)

The organisation's primary activity should be considered when applying the contribution criteria. For example, if an organisation is the integrator of the solution and a component provider, it should consider its primary role as the integrator. Each role is not specific to one organisation and so multiple organisations can qualify under each. For example, deployment of the end-to-end solution may have multiple organisations involved to address different geographies, or in different activities such as physical implementation or analysis of suitable deployment. ICT solutions specifically designed to provide people, organisations, or policy makers with helpful information to support sustainable decisions, that can demonstrate a positive impact as a consequence of using the solution should be considered as eligible solutions and organisations can qualify under criteria (A) (i)-(iv).

The innovator of the end-to-end solution is an organisation that developed the concept of the solution to be ready for market. The innovator is not necessarily responsible for development of the solution for mass manufacture and retail as this may occur by other organisations (e.g. under license) and therefore is differentiated from a developer of the end-to-end solution. This is typically an organisation, but multiple organisations may qualify where partnerships or agreements are in place for joint concept development.

The activities relating to criteria (A) (i)-(iii) refer to the end-to-end solution, this means that the activity undertaken is related to the solution as a whole and not only one component of the solution.

As many organisations' activity could be related to the deployment of the end-to-end solution, criterion (iii) includes a requirement to evidence that the activity increases deployment. Physical deployment of the ICT solution is inherently increasing deployment and therefore qualifies the activity. Supporting activities, such as analysis of suitable deployment are required to demonstrate how their activity increases deployment.

## Box A – Examples of organisational contribution claims for criteria (A)(i)-(iii)

### *Eligible*

- A software platform used to analyse and identify suitable deployments for the sale and installation of solar panels that can demonstrate new installations / sales as a consequence of use of the platform.
- An organisation installs and supports operation of a fleet management solution for end customers where the solution is provided by another organisation.
- A telco provides and operates a platform to optimise load capacity of an electricity transmission system with real-time data and forecasts. The telco integrates IoT hardware and the cloud platform from other providers with their communication infrastructure to increase capacity of the power network.

### *Ineligible*

- An organisation carries out research necessary to bring a solution to market – This is ineligible as the research organisation is not responsible for the innovation of the solution.
- An organisation supporting deployment of power infrastructure for an EV charging solution – This is ineligible as the organisation is only supporting deployment of a component of the solution.

## **Contribution Criteria (B)(i)**

In order for an organisation to make a contribution claim it needs to demonstrate that the component contributing to the ICT solution is not a contributor to the activities under the reference scenario, as this would indicate the component not playing an essential and substantial role in enabling the impacts of the ICT solution compared to the reference scenario. It is important to note that certain components may already exist or be available before the implementation of the ICT solution but were not used by any reference activities and would therefore still meet this requirement.

## **Contribution Criteria (B)(ii)**

In order to ensure high integrity of contribution claims, the component an organisation contributes shall have an essential and substantial role in achieving identified second order or higher effects included in the net carbon impact assessment. Essential requires that the effects of the solution would not occur without the component and substantial requires that the component is directly leading to the effect.

## **Contribution Criteria (B)(iii)**

To support a claim for a component, the organisation should be undertaking activities that contribute to the potential impact provided by the ICT solution, hence making the component specialised. To qualify the component must be developed or modified to make it specific to the ICT solution or be developed with the intent of enabling emissions reductions.

## **Contribution Criteria (B)(iv)**

For an organisation to make a contribution claim for a component, the organisation needs to be able to demonstrate that the components is being used in the specific ICT solution that is being claimed. An explanation should be provided as to how the link between the component and the specific ICT solution is established. Where there is uncertainty around how a component is being used, a contribution claim should not be made.

## **Examples of Contribution Criteria (B): Eligible and ineligible organisational contribution claims for components**

## Box B – Eligible examples of organisational contribution claims for criteria Error! Reference source not found.

*An organisation is contributing a specialised printed circuit board to a building management system (BMS) in a building where the reference scenario is manual control.*

- (i) The component is not contributing to any reference activities.
- (ii) The printed circuit board is essential to the function of the control system and substantial as its use is a fundamental element of the effect.
- (iii) The printed circuit board is specific to the BMS solution and could not be used in a different solution.
- (iv) The organisation can demonstrate the number of printed circuit boards sold to the solution integrator as part of the ICT solution.

*An organisation provides a specialised mobile private network for a manufacturing monitoring system where the reference scenario is routine manual maintenance checks.*

- (i) The component is not contributing to any reference activities.
- (ii) The mobile private network is essential to provide the remote monitoring functions and substantial as it directly enables the avoidance of routine maintenance.
- (iii) The control unit is a specific design for the ICT solution.
- (iv) The organisation can demonstrate the number of control units sold to the solution integrator as part of the ICT solution.

*An organisation provides a sustainable vehicle routing software replacing a prior system.*

- (i) The reference scenario routing software functionality does not prioritise minimising fuel consumption, therefore, this software technology is not contributing to the reference scenario.
- (ii) The software is essential and substantial as it directly enables the reduction in fuel consumption through optimised route selection.
- (iii) The software is not specific to the ICT solution (it can be integrated into multiple solutions), but it was developed with the specialised intent to reduce fuel consumption.
- (iv) The organisation can demonstrate the number of vehicle miles travelled

## **Box C – Ineligible examples of organisational contribution claims for criteria** Error! Reference source not found.

*An organisation is contributing a standard printed circuit board to a building management system (BMS) in a building where the reference scenario is a lower functionality BMS system which was already using the same printed circuit board.*

- (i) No, the component is already contributing to the reference activities.
- (ii) Yes, the printed circuit boards are essential to the functioning of the control system and substantial as the control function is a fundamental element of the effect.
- (iii) No, the printed circuit boards are not specific to the ICT solution, nor are they designed to enable emissions reductions.
- (iv) Yes, the organisation can demonstrate the number of printed circuit boards sold to the solution integrator as part of the ICT solution.

*An organisation provides a power supply for a manufacturing control system where no control system existed previously.*

- (i) Yes, the component is introduced with the ICT solution and is not contributing to any reference activities.
- (i) No, the power source is essential to the functioning of the system, but it is not substantial as provision of power is a basic functionality of any system.
- (ii) No, the power supply is not specific to the ICT solution, nor is it designed to enable emissions reductions.
- (iii) Yes, the organisation can demonstrate the number of power units sold to the solution integrator as part of the ICT solution.

*An organisation provides data visualisation for multiple online solutions expected to include water management systems where no control system existed previously.*

- (i) Yes, the component is introduced with the ICT solution and is not contributing to any reference activities.
- (i) No, the data visualisation is not essential to the functioning of the water management system and is not linked to reduced water usage.
- (ii) No, the data visualisation is not specific to the ICT solution, nor is it designed to enable emissions reductions.
- (iii) No, the organisation cannot demonstrate that the visualisation service is being used as part of the ICT solution.

## 6.2 Claiming Net Carbon Impacts and Attribution

### Requirement

- (A) When making a contribution claim, organisations may claim the total net carbon impact of the ICT solution.
- (B) Organisations shall classify their contribution to the solution as defined in ITU-T L.1480 as A-level, or B-level.
- (C) To enable a claim it shall have been determined and evidenced that the ICT solution meets the ‘Do no significant harm’ across other environmental matters. (see Section 3.9.1).
- (D) Organisations shall consider the potential impact of any effects not quantitatively assessed before making claims of a positive net impact of an ICT solution.
- (E) Claims shall not be made for solutions directly applied to activities involving exploration, extraction, mining and/or production, distribution, and sales of fossil fuels i.e., oil, natural gas, and coal.

### Guidance

#### Claiming Net Carbon Impacts and Attribution (A)

While allocating the net carbon impact across different contributions would be preferable to avoid double counting, research led by the ITU and feedback attained during development of the methodology, confirmed that allocation is currently deemed too complex to be effective in practice. Therefore, this methodology will not apply allocation and will only use attribution to recognise the contribution of the individual organisations involved.

#### Claiming Net Carbon Impacts and Attribution (B)

For transparency purposes, it is important that the contribution of the organisation involved in the development or deployment of the ICT solution and claiming contribution is classified and disclosed. Classification is different to allocation which is the quantification of an organisation’s GHG impact as a portion of the total net carbon impact of the solution.

Further guidance on the different levels is outlined below:

**A-level** – contribution of the integrated solution or the innovation of the solution.<sup>21</sup>

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<sup>21</sup> ITU-T L.1480 only considers A-level as contribution of the integrated ICT solution

**B-level** – contribution of specialised hardware and/or software as a component of the solution.

**C-level** – contribution of platform and generic hardware or software components to the ICT solution. (Note: **C-level contributions do not meet the contribution criteria**. This classification is included for the purposes of completeness and consistency with ITU-T L.1480)

## Claiming Net Carbon Impacts and Attribution (D)

By making a claim, organisations are able to direct both internal and external investments towards ICT solutions that have a positive net carbon impact. As assessments are not required to quantitatively assess higher order effects, claims of a positive impact should not be made without due consideration for their qualitative assessment. If higher order effects are significant, they may not only negate any current positive impacts, but also pose wider reaching risks on the ability to achieve Net Zero. This is particularly relevant for ICT solutions implemented where temporary efficiency and carbon reduction gains could lead to a prolonged reliance on fossil-fuels that is not in line with science-based Net Zero trajectories. To ensure that claims of a net positive impact for ICT solutions are credible, organisations should:

- Ensure that claims are not made when higher order effects are identified that can clearly outweigh the net positive impact (e.g. high magnitude and likelihood).
- Be comfortable publicly communicating the reasoning and justification for the qualitative assessment of the identified higher order effects as unlikely to outweigh the net positive impact.

## 6.3 Reporting Aggregated Impacts of Multiple Solutions

Organisations may want to communicate the aggregated total impact of all ICT solutions they are contributing towards for external reporting purposes, such as reporting against the EU Taxonomy as an organisation, and the EGDC KPIs. There are specific considerations that need to be made when communicating aggregated results of multiple ICT solutions to maintain transparency.

This section provides guidance on reporting aggregated impacts of multiple individual assessments. Aggregated assessments do not typically include all products or services that an organisation supplies and therefore are not a complete picture of their impact. They often only include those solutions that have a net positive impact, this is called cherry picking. While it can provide a useful indicator of the positive impacts an organisation is making, it should be considered that other products and services have not been accounted for and the aggregated assessment does not represent the overall impact an organisation is making. Aggregation also compounds the uncertainties of each solution assessment and introduces challenges relating to double counting of avoided emissions which should be



avoided. Other indicators of the organisation, such as their value chain footprint, may provide further context to their impact and aggregated assessments of one organisation are not comparable with another.

## Requirements

- (A) Organisations may only disclose the aggregated total net carbon impact of ICT solutions where their contribution meets the contribution criteria as defined in the 6.1 Contribution Criteria section.
- (B) The aggregated net carbon impact shall report the ex-post annual net carbon impact of deployed solutions.
- (C) The aggregated total net carbon impact should not double count any emissions between different ICT solutions.
- (D) Organisations may choose to only disclose the net carbon impact of a sub-set of ICT solutions they are contributing towards, however, the communication shall be accompanied by an explanation that the selection of ICT solutions may favour those solutions with a positive impact, and that the overall net carbon impact of the organisation remains unknown.
- (E) Organisations should report the aggregated net carbon impact for the selected deployed solutions supported by other metrics to contextualise their impact:
  - (i) Net annual GHG emissions savings from deployed ICT solutions,
  - (ii) Net annual energy and/or other resource savings, and
  - (iii) Annual revenue from ICT solutions as a proportion of total annual revenue (%).
- (F) Organisations shall communicate a breakdown of their total disclosed aggregated net carbon impact by ICT solution, including the required communication and disclosures for each ICT solution as defined in section 5.

## Guidance

### Reporting Aggregated Impacts of Multiple Solutions (C)

Aggregating individual ICT solution assessments that target different emissions sources and user groups may be achieved by adding the results of individual assessments. Where aggregating individual solutions that target the same emissions sources and user groups, i.e. where boundaries overlap, double counting is likely to occur. To aggregate these solutions the effects of one ICT solution implementation must be calculated first, followed by each other solution in turn where the effects are only related to the remaining emissions from the prior solution implementation. Where this is hard to practically implement, estimations should be made to remove activity from overlapping user groups in order to underestimate the impact.

For example, a portfolio assessment including an e-learning solution and a video-conferencing solution must ensure not to double count avoided travel from the users of both solutions who would be making use of both of these solutions during the same working days.

## **Reporting Aggregated Impacts of Multiple Solutions (D)**

Organisations are permitted to only include a sub-set of their ICT solutions when reporting an aggregated impact as reporting the net carbon impact of all solutions sold can be a considerable undertaking and unlikely to be feasible for many organisations. The reported aggregated assessment is therefore likely to favour inclusion of ICT solutions that have a net positive carbon impact. This is cherry-picking of and in order to avoid misleading environmental reporting organisations are required to disclose that the selection of ICT solutions favours those with a positive impact, and that the overall net carbon impact of the organisation remains unknown.

The benefit of calculating the net carbon impact is to identify organisations whose solutions have significant potential for facilitating atmospheric emissions reductions so that investors can identify them for green investment strategies. It is not necessary for organisational net carbon impact from ICT solutions to be the organisations' total aggregated impact to achieve these goals, but it allows for organisations and investors to track their aggregated impact and progress over time.

Best practice reporting would also communicate product areas of an organisation that are likely to include any ICT solutions that may have a negative net carbon impact. Organisations can present the solutions selected for aggregated reporting together with a list of other solutions which were not selected so that any solution with potential negative effects are transparently disclosed.

## **Reporting Aggregated Impacts of Multiple Solutions (E)**

Organisations should report metrics as specified by the EGDC KPIs to provide transparency on the impact of their ICT solutions:

- Net annual GHG emissions savings from deployed ICT solutions (metric tonnes CO<sub>2</sub>e) and percentage change year-over-year (%)
- Net annual energy and/or other resource savings due to deployed ICT solutions (unit of energy, weight or volume as appropriate) and percentage change year-over-year (%)
- Annual revenue from deployed ICT solutions as a proportion of total annual revenue (%)

In rare cases where solutions don't generate revenue for the organisation, the organisation should report that no revenue was generated and is recommended to select an alternative

metric to demonstrate relative prominence of the solution within the organisation's products and services.

## **Reporting Aggregated Impacts of Multiple Solutions (F)**

The aggregated net carbon impact should be broken down into more granularity, with the total results clearly split by ICT solution. Additionally, the organisation should include the required communication and disclosures for each ICT solution as defined in Section 5. If the results of a net carbon impact assessment were used to estimate the impact of the same ICT solution in other implementation contexts (see Section 4), the estimation approach should be outlined and the percentage of the total net carbon impact of the ICT solution resulting from the estimation disclosed.



## Appendix 1: Abbreviations

- AI – Artificial intelligence
- BAU – Business-as-usual
- BMS – Building management system
- EEIO – Environmentally extended input-output
- EGDC – European Green Digital Coalition
- EU – European Union
- EV – Electric vehicle
- GHG – Greenhouse gas
- GHGP – Greenhouse Gas Protocol
- ICT – Information and communications technology
- IEA – International Energy Agency
- IoT – Internet of things
- ITU – International Telecommunication Union
- kg – kilogram
- km – kilometre
- KPI – Key performance indicator
- LCA – Life cycle assessment
- MPN – Mobile private network
- PV – Photovoltaic
- tCO<sub>2</sub>e – Tonnes of carbon dioxide equivalent
- WBCSD – World Business Council on Sustainable Development

## Appendix 2: Glossary

**Allocation:** quantification of an organisation's GHG impact as a portion of the total net carbon impact of the solution.

**Component:** See 'Solution component'



**EGDC methodology:** term used to refer to this methodology (“Net Carbon Impact Assessment Methodology for ICT Solutions”)

**Embodied emissions:** Embodied emissions, refer to the greenhouse gas emissions that are generated during the extraction, production, transport, and manufacturing stages of a product’s life. They can also be termed as a cradle-to-gate footprint.

**Ex-ante assessment:** a forward-looking assessment of a comparative impact expected to occur in the future.

**Ex-post assessment:** an assessment of a comparative impact that has occurred in the past.

**First order effects:** direct emissions associated with the full life cycle of the implemented ICT solution.

**Functional unit:** the relative unit of emissions reductions selected for the assessment to describe the emissions reductions per unit of the solution.

**Greenhouse Gas:** gases that absorb and emit infrared radiation, therefore contributing to the greenhouse effect.

**Higher order effects:** indirect impacts that result as a consequence of the deployment and use of the solution when compared to the reference scenario, but these effects result as consequences of the second order effects and require behavioural changes, such as changes in consumption patterns, lifestyles, and value systems in order to have an impact. These effects can be positive or negative and they include, but are not limited to, rebound effects.

**ICT infrastructure:** ICT networks or services such as telecommunication network infrastructure, remote data storage, data processing, cloud computing, etc.

**ICT solution scenario:** scenario representing the implementation of the ICT solution.

**ICT solution:** a system of ICT components encompassing ICT goods (digital and non-digital hardware and software) and ICT infrastructure (ICT networks and services) that are combined to deliver a specific service to the user.

**Implementation context:** context in which the solution is implemented, including a set of parameters that describe the context in which the reference and ICT solution scenarios operate.

**Life Cycle Assessment:** the compilation and evaluation of the inputs, outputs, and the potential environmental impacts of a product system throughout its life cycle.<sup>22</sup>

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<sup>22</sup> Definition text from European Platform on LCA

**Net Carbon Impact:** comparison between the GHG impacts of a scenario with an ICT solution (the solution-ICT solution scenario) and a reference scenario without the ICT solution within the same boundary.

**Net Carbon Impact Assessment:** a quantitative and qualitative assessment that compares the GHG impacts of the selected solution-ICT solution scenario and a reference scenario within the same boundary.

**Net environmental impact:** comparison between the environmental impacts of a scenario with an ICT solution (the solution-ICT solution scenario) and a reference scenario without the ICT solution within the same boundary

**Primary data:** data obtained directly from the ICT solution.

**Rebound effects:** long-term second order effects where efficiency improvements realised by the implemented solution subsequently cause an increase in the activity of system resulting in GHG emissions.

**Reference activity:** activity forming the reference scenario to deliver the same service to the user as the ICT solution which is defined by the functional unit.

**Reference scenario:** scenario reflects the situation without the implementation of the ICT solution. It is comprised of reference activities that form the end-to-end process to deliver the same service to the user as the ICT solution which is defined by the functional unit.

**Secondary data:** data obtained from sources other than the ICT solution itself (e.g., literature review, national statistics, etc.)

**Second order effects:** the indirect emissions resulting from use of the solution or reference scenario.

**Sector Methodologies:** set of methodologies providing further guidance on how the requirements in the EGDC methodology can be applied for specific sectors (construction/buildings, energy/power, smart cities, agriculture, transport, manufacturing).

**Solution component:** A digital or non-digital hardware or software that forms part of the ICT solution.

## Appendix 3: Reference Materials

Carbon Trust (2017). [ICT Sector Guidance built on the GHG Protocol Product Life Cycle Accounting and Reporting Standard](#).

Council of the EU (2020). [Digitalisation for the benefit of the environment: Council approves conclusions](#).

EGDC (2022). [European Green Digital Coalition, The Declaration](#).

European Commission (n.d.) [European Platform on LCA](#).

European Parliament, European Council (2020). [Regulation \(EU\) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation \(EU\) 2019/2088](#).

European Parliament, European Council (2021). [Commission Delegated Regulation \(EU\) 2021/2139 of 4 June 2021 supplementing Regulation \(EU\) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives](#).

Greenhouse Gas Protocol (2005). [The GHG Protocol for Project Accounting](#). World Resources Institute and World Business Council for Sustainable Development.

Greenhouse Gas Protocol (2011). [Product Life Cycle Accounting and Reporting Standard](#). World Resources Institute and World Business Council for Sustainable Development.

Greenhouse Gas Protocol (2014). [Policy and Action Standard](#). World Resources Institute.

ITU (2014). ITU-T L.1410 - [Methodology for environmental life cycle assessments of information and communication of technology](#).

ITU (2022). ITU-T L.1480 - [Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors](#).

Joint Research Centre, European Council (2022). [The twin green & digital transition: How sustainable digital technologies could enable a carbon-neutral EU by 2050](#).

Mission Innovation (2020). [The Avoided Emission Framework \(AEF\)](#).

WBCSD (2023). [Guidance on Avoided Emissions: Helping business drive innovations and scale solutions toward Net Zero](#). World Business Council for Sustainable Development.

WRI (2019). [Estimating and reporting the comparative emissions impacts of products](#).

## Appendix 4: Alignment to ITU-T L.1480

Please see detailed below the material differences identified between the ITU-T L.1480 and the EGDC Net Carbon Impact Assessment Methodology. This review is our interpretation of differences between the documents.



<u>ITU Assessment Types (ITU-T L.1480, Section 1)</u>	
ITU	<p>“Assessment of the second order effect of one or several ICT solution(s) implemented in a specific context by the user of an ICT solution while also considering higher order effects.”</p> <p>“Assessment of the second order effect of one or several ICT solution(s) implemented at different scales, including at an organizational level (whether private or public organizations), at a city level, at a country level or at worldwide level, while also considering higher order effects.”</p> <p>“Assessment of the second order effect of one or several specific ICT solution(s) from the perspective of an ICT organization contributing to ICT solution(s) while considering also higher order effects. This includes:</p> <ul style="list-style-type: none"> <li>• Assessment of the aggregated effect of all ICT solutions provided by an ICT organization across all customers;</li> <li>• Assessment of the aggregated effect of one or more ICT solutions provided by an ICT organization across some customers;</li> </ul> <p>Assessment of the effect of one or more specific ICT solutions implemented in an actual context for a specific customer.”</p>
EGDC	<p><b>Section 3, 4 and 5</b></p> <p>EGDC Method does not include simultaneous assessment of several ICT solutions.</p>
<u>Net second order effect (ITU-T L.1480, Section 7)</u>	
ITU	<p>“This Recommendation has been developed to support the assessment of the net second order effects of ICT solutions. The net second order effect is the resulting second order effect after accounting for the emissions due to the first order effects of an ICT solution.”</p>
EGDC	<p><b>Section 1</b></p> <p>EGDC Method does not refer to “net second order effects”. The Recommendation ITU-T L.1480 uses the terminology “net second order effects” to represent the combined impact of first and second order effects and reports higher order effects separately. This is because higher order effects can be hard to assess and may not be included quantitatively in the assessment. To simplify terminology, the EGDC methodology has opted to use the term “net carbon impact” for the assessment including impacts of all effects together but reporting where higher order effects</p>

	have only been assessed qualitatively. All effects are required to be reported separately.
<b>Define the aim and type of the assessment (ITU-T L.1480, Section 10.1.1)</b>	
<b>ITU</b>	“This first step corresponds to the definition of the aim of the assessment. In particular, it shall define whether the assessment focuses on a specific implementation of one or several ICT solution(s) (clause 11), a general usage of one or several ICT solution(s) (clause 12), or the impact from an ICT company's perspective (clause 13).”
<b>EGDC</b>	EGDC Method refers to assessment types in section 3.2.1, however, it more commonly discusses single/multiple implementation contexts. The assessment under the EGDC method only applies to specific implementations of one ICT solution.
<b>Define the assessment depth: Tier 1, Tier 2 or Tier 3 (ITU-T L.1480, Section 10.1.2)</b>	
<b>ITU</b>	<p>“Before starting the assessment, the practitioner shall decide its intended depth. This Recommendation refers to three tiers of assessments:</p> <ul style="list-style-type: none"> <li>a) Tier 1 assessments: Tier 1 assessments shall assess net second order effects and shall also assess impact from contextual factors and higher order effects, by quantitative means if such assessment is considered robust, or else by qualitative means. These assessments are the most in-depth ones.</li> <li>b) Tier 2 assessments: Tier 2 assessments shall assess net second order effects and shall identify contextual factors and higher order effects. These are assessments of intermediate depth which do not assess the magnitude of higher order effects.</li> <li>c) Tier 3 assessments: Tier 3 assessments shall consider net second order effects and should identify contextual factors and higher order effects. These are the simplest assessments and are not considered rigorous.”</li> </ul>
<b>EGDC</b>	<p><b>Claiming Net Carbon Impacts as an Organisation</b></p> <p>EGDC Method does not include in categorization of assessments by Tier. The net carbon impact assessment aligns to the requirements of a Tier 1 assessment as specified in Table 2 of ITU-T L.1480 and does not consider Tier 2 or 3 assessments.</p>
<b>Identification of Second Order Effects (ITU-T L.1480, Section 10.2.6.2)</b>	
<b>ITU</b>	“The effects of introducing an ICT solution may be immediate or mid- or long-term. Those two categories shall be kept separate in the assessment, and it is noted that

	mid- or long-term effects may be associated with changes in conditions such as policy changes.”
<b>EGDC</b>	<p><b>Section 3.4.5</b></p> <p>EGDC Method does not differentiate mid- or long-term effects from other effects. Instead, mid- or long-term effects will be included under second order or higher order effects.</p>
<b>Evaluation of the Applied Method (ITU-T L.1480, 10.4.1)</b>	
<b>ITU</b>	ITU-T L.1480 provides a list of questions for the user to evaluate the applied method of the assessment and interpret the results.
<b>EGDC</b>	EGDC Method refers to the ITU questions in section 3.7 of the methodology but does not include them verbatim in the text.
<b>Reporting (ITU-T L.1480, Section 10.5)</b>	
<b>ITU</b>	<p>“The report shall include descriptions of:</p> <ul style="list-style-type: none"> <li>• The aim and type of assessment (see clauses 7 and 10.1.2 for details).</li> <li>• The assessment depth (Tier 1–3) and an associated disclaimer regarding any uncertainty and limitations in results, particularly mentioning that the results are only valid under the conditions of the study and that the assessment of second order effects are always hypothetical by comparing impacts with a reference scenario.</li> <li>• The intended receiver and audience”</li> </ul>
<b>EGDC</b>	<p>EGDC Method does not distinguish between assessment Tiers.</p> <p>EGDC Method includes reporting of the objective of the assessment which can include the intended receiver and audience but is not explicitly stated.</p>
<b>ITU</b>	<p>“In cases where the assessment is based on case studies (See clause 12), also, in addition to the previous bullets, describe:</p> <ul style="list-style-type: none"> <li>• The set-up of any case study and its relevance (time, number of samples, representativeness etc.).</li> <li>• The footprint of the ICT solution in the case study (or state clearly if that is not considered and why).</li> </ul>

	<ul style="list-style-type: none"> <li>Describe also how an estimate of the ICT solution's emission reduction was derived from case studies taking into account any differences in their quality while considering the principles of transparency and conservativeness."</li> </ul>
<b>EGDC</b>	EGDC Method aligns with this guidance but does not specify it as specific guidance for case studies.
<b>ITU</b>	ICT solutions designed so that their use will reduce GHG emissions shall be listed separately from ICT solutions whose use may generate GHG emissions reductions.
<b>EGDC</b>	EGDC Method does not include the need to report this distinction alongside claims.
<b>ITU</b>	If applicable, describe also suggested countermeasures to address negative higher order effects. Moreover, describe measures to suppress obstacles and magnify incentives to leverage the potential benefit of the ICT solution. Additionally, highlight that knowledge of rebound should not be used as an excuse to not increase environmental efficiencies of solutions and systems.
<b>EGDC</b>	<p>EGDC Method includes the reporting of suggested countermeasures to address higher order effects, however it does not include the reporting of measures to leverage the potential benefit of the ICT solution nor the reporting of the reminder that knowledge of rebound should not be used as an excuse to not increase environmental efficiencies of solutions and systems.</p> <p>Guidance on these points has been provided separately as part of the Deployment Guidelines, though these guidelines also do not include the need for these points to be reported.</p>
<b>ITU</b>	Concrete actions on how to reduce negative impacts and increase positive impacts shall be presented and added in communication to direct stakeholders such as customers.
<b>EGDC</b>	EGDC Method does not include the reporting of actions on how to reduce the negative impacts and increase positive impacts. Guidance on these has been provided separately as part of the Deployment Guidelines, though these also do not include this as a reporting requirement.
<b><u>Identification of ICT solution(s) (ITU-T L.1480, Section 13.1)</u></b>	
<b>ITU</b>	In cases where only a part of the portfolio is considered, a percentage of turnover or similar shall be referred to, rather than comparing the result to the overall footprint.

<b>EGDC</b>	EGDC Method requires reporting of annual revenue from ICT solutions as a proportion of total annual revenue (%) when reporting aggregated impacts.
<b><u>Implementation Context</u></b>	
<b>ITU</b>	ITU-T L.1480 refers to contextual factors related to the implementation of ICT solution scenarios against the reference scenarios.
<b>EGDC</b>	This methodology has an equivalent approach, however, it uses the term implementation context as well as contextual factors and has decided to make mandatory the reporting of this distinction between the context from the reference scenario and ICT solution scenario to aid assessors in defining the reference and ICT solution scenarios through consideration of the services they provide separately to the context they operate in.

## Appendix 5: Alignment to WBCSD Guidance on Avoided Emissions

The WBCSD Guidance on Avoided Emissions is broader in scope than this EGDC Net Carbon Impact Assessment Methodology for ICT Solutions. The WBCSD guidance addresses any industrial solution apart from some selected areas, such as digital services, advertising, and advisory as they have specified in section 1.4 *Scope of the Guidance*. The WBCSD Guidance on Avoided Emissions is a guidance document that includes a methodology (Sections 5 and 6), therefore, this review of alignment between these two documents shall only compare the respective technical assessment methodologies. As such this review only considers Sections 5 and 6 of the WBCSD Avoided Emissions Guidance as its other sections are incomparable as they serve different purposes. This review is our interpretation of differences between the documents.

<b><u>Scope of the Guidance (WBCSD, Section 1.4)</u></b>	
<b>WBCSD</b>	“This guidance focuses solely on avoided emissions generated through the introduction of solutions (e.g., products, services, technology, projects). Although essential levers for the transition of society, this version does not yet address the sphere of advisory, influence, prescription, digital services, nudges or advertising in avoided emissions assessments. Guidelines on how to account for avoided emissions associated with these will be explored in future revisions of the guidance.

	The guidance also does not cover avoided emissions through the financing of climate mitigation projects, and is thus not intended to create or expand a voluntary crediting mechanism nor a crediting mechanism under Article 6 of the Paris Agreement”
<b>EGDC</b>	The WBCSD Guidance is broader in scope, the EGDC Method focuses specifically on providing a methodology on how to account for the net carbon impact (positive and negative) associated with ICT solutions.
<b>Identifying the Timeframe of the Avoided Emissions Assessment (WBCSD, Section 5.3)</b>	
<b>WBCSD</b>	<p>“Approach A – Forward-looking avoided emissions. If a solution’s life cycle emissions are assessed and reported in the year of transaction in the company’s GHG inventory, (e.g., Use of Sold Products – Category 11 Scope 3), then avoided emissions should also be assessed in the year of sale for the solution’s entire life cycle. This option is particularly intended for companies that do not precisely monitor the use of solutions sold during their lifetime, or those wishing to understand the long-term implications of a given solution to define their strategy moving forward.</p> <p>Approach B – Year-on-year avoided emissions. If a solution’s emissions are assessed and reported annually in a company’s GHG inventory (e.g., Scope 1 or Downstream Leased Assets – Category 13 Scope 3), then avoided emissions should be assessed every year.”</p>
<b>EGDC</b>	While both EGDC and WBCSD emphasize defining the time boundary for assessments, the EGDC Method uses the concept of actual and potential effects as aligned to the ITU-T L.1480, allowing assessors to choose between ex-post and ex-ante assessments. Actual effects, akin to ex-post assessments, consider historical impacts from solution implementation to the current point or its end. Potential effects, resembling ex-ante assessments, contemplate future impacts from the current point in time to the end of the solution’s life.
<b>Forward-looking Avoided Emissions (WBCSD, Section 5.3.1)</b>	
<b>WBCSD</b>	<p>“If a solution avoiding emissions is one sold to end users, its avoided emissions should be calculated for its entire life cycle and reported in the year of sale.</p> <p>This rule is consistent with a company’s reporting of the use phase emissions of a solution, which are also calculated on the solution’s entire lifetime and reported in the year of sale in the “Use of Sold Products” Scope 3 category.</p> <ol style="list-style-type: none"> <li>1. Establish a solution’s future emissions pathway and assess the volume of greenhouse gases the solution is likely to emit during its entire lifetime (see Section 5.6.1).</li> <li>2. Establish the emissions pathway in the reference scenario and assess the volume of GHG emissions that would have been emitted during the solution’s entire lifetime.”</li> </ol>

EGDC	<p>For solutions sold to end users, the WBCSD Guidance requires quantification of entire lifecycle impact. The EGDC Method on the other hand allows assessors to define the assessment perspective based on the intended objective of the assessment. It differentiates between two types of assessment perspectives:</p> <ol style="list-style-type: none"> <li>1) Actual effects consider the historical effects that have occurred following solution implementation. An ex-post assessment of the solution implementation until the current point in time or after the end of its life. The time boundary can be for the full lifetime of the solution until the point in time of the assessment (i.e. the cumulative impact over the lifetime), or they can be specified for a shorter period of time (e.g. annual reporting).</li> <li>2) Potential effects consider the future effects that could occur following solution implementation. An ex-ante assessment of the solution before it is implemented or from the current point in its implementation until the end of its life.</li> </ol>
<b><u>Year-on-Year Avoided Emissions (WBCSD, Section 5.3.2)</u></b>	
WBCSD	<p>“1. Calculate the solution’s upstream and end-of-life emissions and reference and distribute them accordingly across their lifetime.”</p>
EGDC	<p>The EGDC Method does not necessarily require the assessment of the First Order Effects of the Reference Scenario. It is assumed that these are already in existence and therefore the emissions will already have occurred.</p> <p>Note: The EGDC Method does align to WBCSD Section 5.3.2 Step 2 and Step 3.</p> <p>Step 2: “Establish on a yearly basis the use-phase emissions and the reference usage scenario for that year. This reference scenario should account for the evolution of the reference solution’s performance over time, considering additional knowledge about market changes, as well as potential replacements during the contract.”</p> <p>Step 3: “Assess annual avoided emissions by calculating the difference in emissions of a reference activity with and without the solution being used, taking into consideration the solution’s entire life cycle.”</p>
<b><u>Defining the Reference Scenario – How to define the ‘average solution’ (WBCSD, Section 5.4.1)</u></b>	
WBCSD	<p>“Existing Demand</p> <p>If the solution optimizes an existing solution (“improvement case”):</p> <ul style="list-style-type: none"> <li>• If this improvement is not imposed by exogenous factors (such as regulation), the reference should be the continued use of the previous system without the improvement brought about by the solution</li> <li>• If this improvement is imposed by exogenous factors (such as regulation), the reference should be the average market solution to perform this kind of improvement</li> </ul>



	<p>If the solution replaces an existing one ("replacement case"):</p> <ul style="list-style-type: none"> <li>• If the replacement is not imposed by regulation, the reference should be the average solution that is chosen by the market to replace the existing one in the year of sale."</li> </ul>
<b>EGDC</b>	<p>The EGDC Method defines that the Reference Scenario should be determined as the most likely alternative scenario in the event the solution is not/was not implemented and is aligned with WBCSD guidance with the exception of whether or not the solution is imposed by exogenous factors. See Section 3.2.5 of the EGDC Method for more information.</p>
<b>Definition of the Scope and Boundaries (WBCSD, Section 5.5.1)</b>	
<b>WBCSD</b>	<p>The timeframe used to assess avoided emissions shall not exceed the timeframe associated with the solution's life cycle.</p>
<b>EGDC</b>	<p>The EGDC Method includes the assessment of Higher Order Effects. Higher Order Effects are indirect impacts that occur as a consequence of the second order effects and often occur following behavioural or structural changes, such as changes in consumption patterns, lifestyles, and value systems in order to have an impact. These effects can be positive or negative and they include, but are not limited to, rebound effects. In particular the effects tend to occur over a longer timeframe – a timeframe which may surpass that of the solution's life cycle.</p>
<b>Attributional and Consequential Approaches (WBCSD, Section 5.5.2)</b>	
<b>WBCSD</b>	<p>WBCSD doesn't impose either methodology but does request that companies provide a justification in either case and document the selected approach.</p>
<b>EGDC</b>	<p>The EGDC Method focuses on the Consequential Approach, by including Higher Order Effects, however, the attributional approach is also used to assess the First Order Effects and can be used to assess Second Order Effects (this is at the discretion of the assessor)</p>
<b>Calculation Consistency (WBCSD, Section 5.5.3)</b>	
<b>WBCSD</b>	<p>"B) Consistency with GHG inventory (Pillar A) Companies shall ensure consistency between the avoided emissions (Pillar B) and generated emissions (Pillar A) they declare. To claim avoided emissions associated with the introduction of a decarbonizing solution, a company shall account for the carbon footprint of this decarbonizing solution in its Pillar A."</p>
<b>EGDC</b>	<p>The EGDC Method focuses on providing a methodology for assessing the net carbon impact of ICT solutions. Considerations in relation to Scope 1, 2, and 3 are outside of the scope of this methodology.</p>
<b>Assessing Avoided Emissions (WBCSD, Section 5.6)</b>	

<b>WBCSD</b>	“Avoided emissions are assessed by calculating the difference in emissions of a reference activity with and without the solution being used, taking the solution’s entire life cycle into consideration.”
<b>EGDC</b>	<p>The EGDC Method fully aligns with the approach outlined in the WBCSD Guidance, however, the EGDC Method disaggregates the calculation by assessing the First Order Effects (the direct impacts associated with the life cycle of the ICT solution), Second Order Effects (the indirect impacts that occur as a result of changes to the reference activities following the deployment and use of the solution), and Higher Order Effects (indirect impacts that occur as a consequence of the second order effects and often occur following behavioural or structural changes, such as changes in consumption patterns, lifestyles, and value systems in order to have an impact) separately. The EGDC Method encourages a quantitative assessment of Higher Order Effects where it is possible in addition to a qualitative assessment.</p> <p>The WBCSD Guidance does not specify what effects must be quantitatively assessed but it is inferred that all effects that can be calculated should be assessed, and therefore, the approaches are equivalent. The WBCSD Guidance also explicitly require a qualitative assessment of Higher Order Effects by requiring identification and communication of rebound effects.</p>
<b>Assessing the Specificity Level of a Claim (WBCSD, Section 5.8)</b>	
<b>WBCSD</b>	Table 4: The various layers of specificity that can be adopted for both solution and reference emissions calculations.

	Approach	Specificity	Description																						
			Solution (S)	Reference (R)																					
	User-specific (or "Customer-specific")	<b>High</b> Recommended approach for specific solution assessments whenever data is accessible and assessments remain feasible with a reasonable number of resources	Specific life cycle emissions of each solution sold. The company performs a detailed calculation for each solution, considering specific usage scenarios  Example: life cycle emissions of a specific electric vehicle sold by a company in Germany	Specific reference for each customer who uses a company's solution. The company performs a detailed calculation for each solution, with detailed knowledge of the context  Example: reference behavior that the owner of this specific car would have adopted instead																					
	Company-specific	<b>Medium</b> Recommended if the calculation of a solution's life cycle emissions or reference is too complex at the scale of each sale	Average life cycle emissions of a solution, specific to a company. The company performs a detailed calculation, considering a usage scenario by solution range and by market in which the solutions are sold  Example: average life cycle emissions of all electric vehicles of the same type sold by a company in Germany	Average reference for a given company's solution sold in a given market. The company performs a detailed calculation, considering a reference scenario for each solution line and each market in which the solutions are sold  Example: reference behavior that a company's average customer would have adopted instead																					
	Market average	<b>Low</b> Recommended for market averages and preliminary evaluations of avoided emissions	Average life cycle emissions of the solution in a given market  Note: In this approach, emissions are not specific to the company and can be standardized for a given type of solution in a given geography  Example: average life cycle of a B-segment electric vehicle, all brands combined, sold in Germany	Average reference of the solution in a given market  Note: In this approach, the reference situation is not specific to the company and can therefore be standardized for a given solution in a given geography  Example: reference behavior that an average German owner of a B-segment electric vehicle would have adopted instead																					
<p>Table 5: Specificity levels matrix for avoided emissions claims</p> <table> <tr> <th rowspan="5">Reference scenario (R)</th><th colspan="4">Solution (S)</th></tr> <tr> <th>Specificity level</th><th>Solution Specific (1)</th><th>Company Specific (2)</th><th>Statistical (3)</th></tr> <tr> <td>Solution Specific (1)</td><td>Very high</td><td>High</td><td>Medium-high</td></tr> <tr> <td>Company Specific (2)</td><td>High</td><td>Medium</td><td>Medium-low</td></tr> <tr> <td>Statistical (3)</td><td>Medium-high</td><td>Medium-low</td><td>Low</td></tr> </table>					Reference scenario (R)	Solution (S)				Specificity level	Solution Specific (1)	Company Specific (2)	Statistical (3)	Solution Specific (1)	Very high	High	Medium-high	Company Specific (2)	High	Medium	Medium-low	Statistical (3)	Medium-high	Medium-low	Low
Reference scenario (R)	Solution (S)																								
	Specificity level	Solution Specific (1)	Company Specific (2)	Statistical (3)																					
	Solution Specific (1)	Very high	High	Medium-high																					
	Company Specific (2)	High	Medium	Medium-low																					
	Statistical (3)	Medium-high	Medium-low	Low																					
EGDC	<p>The EGDC Method does not lay out different approaches. Instead it acknowledges that data availability may be a limiting factor for many organisations to make specific calculations and offers the possibility of different levels of data, including the option of a qualitative assessment to help companies assess the potential order of magnitude of a GHG impact relative to the magnitude of other identified first, second, or higher order effects.</p> <p>The EGDC Method also includes a data availability and quality assessment approach, whereby this should be carried out for all activities and activity emission intensities</p>																								

	identified for each effect included in the net carbon impact assessment. The data availability and quality assessment shall be used to select the most appropriate data sources and determine the level of quality of the net carbon impact assessment.
<b>Guidelines for Reporting Avoided Emissions (WBCSD, Section 6.1.1)</b>	
<b>WBCSD</b>	<p>“1. Avoided emissions shall always be reported separately from:</p> <ul style="list-style-type: none"> <li>• GHG inventory footprints</li> <li>• Carbon sinks</li> <li>• Financial contributions to transition (abatement, avoidance or removals) outside of the value chain</li> </ul> <p>2. Avoided emissions shall not be used to claim a company’s carbon neutrality, net zero emissions or any other claims implying a company’s absence of impact on the climate.”</p>
<b>EGDC</b>	<p>The EGDC Method focuses on solutions and the assessments of net carbon impact, while the WBCSD Guidance provides a more company-centric approach. As such, guidance relating to other environmental company claims, reporting, or targets sits outside of the scope of this methodology.</p> <p>Assessments of the impact of ‘financial contributions to transition’ also do not come under the EGDC Method.</p>
<b>WBCSD</b>	“6. Avoided emissions shall not be communicated externally without specifying which percentage of total revenue the solutions generating those avoided emissions represent.”
<b>EGDC</b>	The EGDC Method encourages organisations communicating results from a net carbon impact assessment of a single ICT solution to disclose a relative metric related to the business operations, e.g. percentage of total revenue associated with the solution. This is a recommendation, rather than a requirement.

## Appendix 6: Reference Scenario Selection

*(The reasoning included in this section is based on our interpretation of the EU Taxonomy requirements and of typical scenario definition descriptions)*

The most likely alternative reference scenario definition represents the most likely emissions scenario in the absence of the ICT solution. Therefore, the outcome of a valid assessment that represents the most likely GHG impact of the ICT solution which only results in positive impacts where net emission reductions have occurred (a benefit from the status quo), no impact where effects are neutral, and negative impacts where net

emissions increase. While this may seem self-evident selection of a different reference scenario does not necessarily generate this result.

The EU Taxonomy requires that the *best performing alternative* reference scenario is used only in the situations where an alternative solution/technology is already available on the market, but it does not specify requirements for other situations, i.e. where there is no ICT solution. The outcome of an assessment using the best performing alternative reference scenario can only show a positive impact on the environment if the solution is best in class. This is not a reflection of reality as there may be multiple solutions that can deliver a positive impact on the environment. This requirement would therefore restrict only the best-in-class solution to be classified as “environmentally sustainable” economic activities under the EU Taxonomy. Furthermore, as there is no requirement for a reference scenario where there is no alternative ICT solution, these assessments are able to choose any reference scenario that would withstand critical review and qualify as “environmentally sustainable” economic activities under the EU Taxonomy with a more achievable criterion. The result is inconsistency in classification of “environmentally sustainable” economic activities under the EU Taxonomy.<sup>23</sup>

Other considerations that led to the most likely alternative selection as the reference scenario criterion where data availability and consistency. The most likely alternative can use secondary data from governments, regional bodies, industries, etc. to support identification of average consumer behaviours or purchasing decisions, whereas the best performing alternative will require specific data from one alternative that may be unavailable as commercially sensitive. The ability to consistently define the best performing alternative is also challenging, particularly where there is sparse data available which would lead to inconsistency in assessment outcomes.

An alternative reference scenario considered was the non-existence of ICT solutions, i.e. when the reference scenario is selected to consider the alternative if no other ICT solution was used. While this can be a valid scenario when there are no alternative ICT solutions, it overestimates positive impacts where other lower performing ICT solutions are available. This approach is lacking consideration of the business-as-usual use of ICT solutions and is not a reflection of reality. The assessment can overestimate the positive impact when it may no longer be any positive impacts on the environment as a consequence of the ICT solution.

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<sup>23</sup> EU taxonomy text extracted from [EU Taxonomy Navigator \(europa.eu\)](#) and [Data-driven solutions for GHG emissions reductions \(europa.eu\)](#)

## Appendix 7: EGDC KPIs

For ICT solutions that have a positive net GHG emissions impact, the KPIs to be reported are:

- Net annual GHG emissions savings from deployed ICT solutions (metric tonnes CO<sub>2</sub>e) and percentage change year-over-year (%)
- Net annual energy and/or other resource savings due to deployed ICT solutions (unit of energy, weight or volume as appropriate) and percentage change year-over-year (%)
- Annual revenue from deployed ICT solutions as a proportion of total annual revenue (%)

The above KPIs were selected for their capability to track the impacts of successful ICT solution deployment, in terms of climate, resource and financial impact, thereby providing evidence of progress against Action 1 of the EGDC Declaration.

KPIs are to be reported at the company level and their calculation is to be aligned with this methodology.

## Appendix 8: Example Disclosure for the Net Carbon Impact Assessment of an ICT solution

Name of solution	
Description of solution	Description of how the solution works and where relevant, which human need it addresses
Deployment of solution	Description of where the solution is deployed currently (sector, geography) and where it has the potential to be deployed
Image of solution or application of solution (if relevant)	
Functional Unit	Description of functional unit and justification for why it was chosen

<b>Reference scenario</b>	<i>Description of reference scenario and justification for why it was chosen</i>
<b>Description of second order effects</b>	<i>Description of all second order effects and explanation of how they reduce GHG emissions</i>
<b>Description of higher order effects</b>	<i>Description of all higher order effects and explanation of how they reduce GHG emissions</i>
<b>Mapping of second order and higher order effects</b>	
<b>Components of the solution</b>	<i>Description of all components that are required for the solution to work, broken down into digital and non-digital components and highlighting whether they are part of the reference scenario</i>
<b>Categorisation of digital technologies</b>	<i>List of all digital technologies of the solution that are not part of the reference scenario split by categorisation (A,B,C)</i>
<b>Description of calculation</b>	<i>High-level explanation of the calculation approach for the different elements of the calculation: 1<sup>st</sup> order effects, second order effects and higher order effects</i>
<b>Net Carbon Saving Impact of the Solution</b>	<i>Total carbon saving impact</i> <i>Savings from reference scenario (%)</i> <i>Saving per functional unit</i>
<b>Assumptions</b>	<i>List of all key assumptions made in the calculations</i>
<b>Data sources</b>	<i>List of all key data sources used in the calculations</i>
<b>Input adjustments and key considerations for usage of results</b>	<i>Description of all input adjustments</i>



	List of things to consider if using results in other use cases
'Do no harm' criteria	Justification that the solution does not cause significant harm in other ESG areas

