EGDC Case study - Colt Smart Building

October 2025

Case Study Methodology

EUROPEAN GREEN DIGITAL COALITION

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1 Introduction

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

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

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

This case study methodology accompanies the '*Colt Smart Building*' case study calculator and provides further details, additional context and transparency around the case study calculator to ensure the outcomes of the case study are interpreted and used correctly.

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

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

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

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

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

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

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

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

2 Results

ICT Solution and assessment overview

Colt’s Smart Building project, launched in 2023 in partnership with Nuuka, uses Artificial Intelligence and Machine Learning with existing HVAC systems to dynamically adjusts settings of ventilation fans to achieve minimum energy consumption while maintaining required indoor air quality standards.

Without this solution, buildings are often designed for “worst-case” operating conditions, which results in HVAC systems being configured for maximum occupancy rather than real-world use leading to unnecessary energy consumption and higher emissions.

This case study is an ex-post assessment carried out on Colt’s own building in London collecting data for a period of 4 months.

Quantified impacts

Assessment period:	1 year
Net carbon impact range:	-6.1 to -12.3 tCO2e
Net carbon impact:	-8.7 tCO2e
Net impact per sqm:	-1.2 kgCO2e/year

Organisational contribution

Colt & Nukka partnered to innovate, develop, and deploy the solution. This aligns with A-level classification as defined by ITU-T L.1480 (contribution of the integrated solution or the innovation of the solution).

Other identified impacts

Reduction in energy use leads to significant cost savings for the building operator. If all cost savings are invested into typical business carbon-intensive activities, this increase in emissions could result in a ~20% reduction of the total net impact.

However, Colt and Nuuka are actively exploring measures to ensure that cost savings are re-invested in ways that further reduce emissions rather than increase them.

Improved air quality and working conditions, contribute directly to occupant's well-being and comfort which may lead to higher occupancy rates in buildings. Low risk of increased energy consumption.

3 Methodology

Name of solution	
Assessment Objective	The purpose of this assessment is to quantify the avoided emissions from Colt's Smart Building project by comparing the energy performance of HVAC systems, specifically – ventilation, before and after implementation of AI optimization. The output of the assessment will demonstrate the solution's impact on electricity consumption and CO_2 emissions reductions. The assessment will focus on a single implementation context: Colt's office building located in London with a floor area of 7,432 m². An ex-post assessment will be conducted, drawing on operational data from before and after solution deployment to establish a robust comparison.
Solution Description	Buildings are often designed for "worst-case" operating conditions, which results in HVAC systems being configured for maximum occupancy rather than real-world use. This approach leads to unnecessary energy consumption and higher emissions. Colt's Smart Building project, launched in 2023 in partnership with Nuuka, addresses this challenge by integrating Artificial Intelligence and Machine Learning with existing HVAC systems (fans usage in the context of this application). The solution connects via Colt's uCPE device and Nuuka's Virtual BMS Gateway. Indoor air quality sensors continuously measure CO_2, temperature, and humidity, providing real-time inputs to the system. Every 1–5 minutes, the AI/ML model learns the building's behavior and dynamically adjusts HVAC settings, particularly the operation of ventilation fans, to achieve minimum energy consumption

<table>
<tr><td></td><td>while maintaining required indoor air quality standards.

The avoided emissions mechanism is achieved by reducing electricity demand for HVAC operations, thereby lowering the associated CO_2 emissions from electricity generation.</td></tr>
<tr><td>Solution Boundary</td><td>The solution consists of an office-based smart HVAC management system integrating the following components:

Digital components:
Network appliance
Gateway enabling interoperability and data management.
IOTSU sensors monitoring temperature, humidity & pressure' differentiation
Cloud storage
Real-time AI/ML optimization controlling HVAC operation.
Non digital components:
Ventilation system (fans) integrated into the building's HVAC infrastructure.
These components work together to enable automated, data-driven control of the ventilation system within the office building.</td></tr>
<tr><td colspan="2">Components of the solution:

Network appliance

Cloud storage (Azure cloud)


30 IOTSU sensors
26 - temperature & humidity
4- differential pressure


Access Point for LoRa technology</td></tr>
<tr><td>Functional Unit</td><td>CO2 emissions reduction per square meter of office space per year</td></tr>
<tr><td>Calculation Boundary</td><td>The calculation represents a one-year period. The annual value is extrapolated from measured data collected between 1st of March 2025 and 30th of June 2025.</td></tr>
</table>

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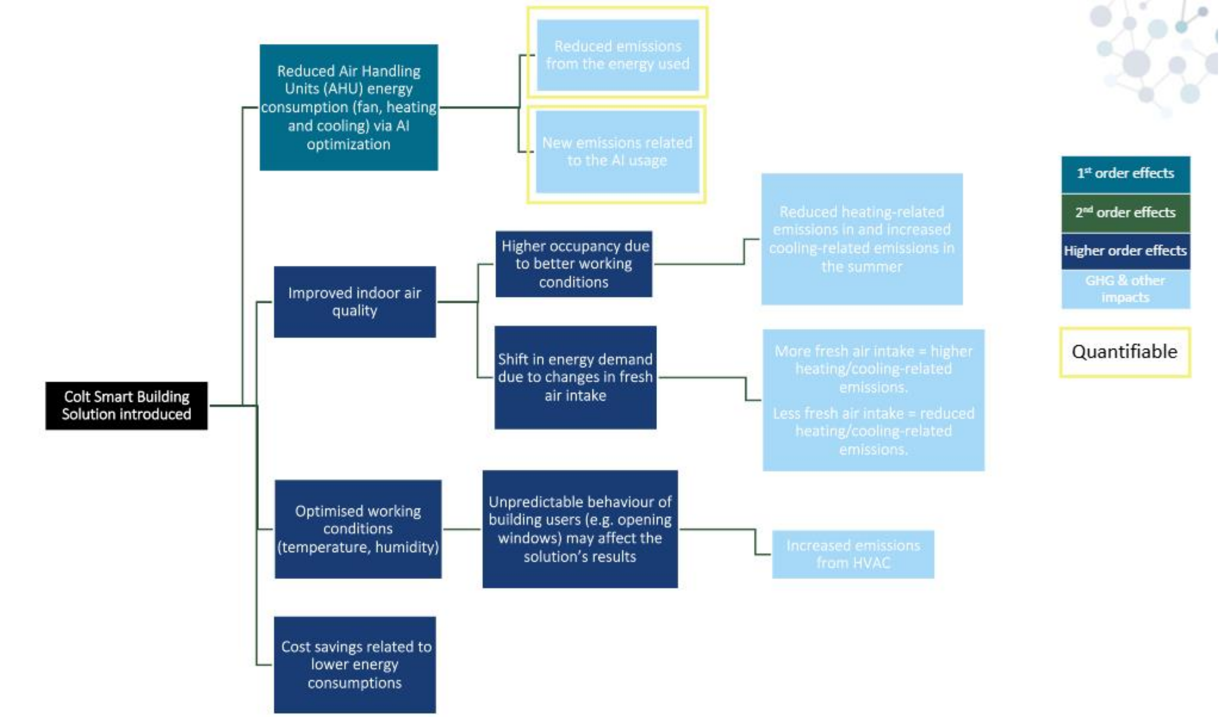
	The geographic boundary of the solution is limited to London, United Kingdom, where the office building implementing the solution is located.
Reference scenario	In the reference scenario, Colt's office building in London, UK, with a floor area of 7,432 square meters, operates with a manual and static HVAC system, typically configured for the maximum occupancy of the building. The reference scenario only considers ventilation part of the HVAC system at this stage. Energy consumed by the previous HVAC system (pre-optimization) has been calculated hypothetically, as a comparator by running the reference model in parallel with the actual, live AI-driven fan speeds, to the solution scenario over the period from 1 March 2025 to 30 June 2025. The hypothetical energy consumption is calculated based on the formula: **AHU Nominal FAN power [kW] × AHU FAN speed(s) [%].** This method determines the energy use of the Air Handling Unit (AHU) fans. The reference consumption is calculated using this formula but based on fan speeds from a selected historical period when fan operation was controlled entirely by the Building Management System (BMS) (before AI optimization). Savings (in kWh) at each time point are calculated as: **Savings (kWh)=Reference Fan Consumption (kWh)−Actual Fan Consumption (kWh).** Energy consumption was measured in kWh and only accounted for working days (Monday to Friday), when the office building was in operation. The collected data was then extrapolated to an annual value by first calculating the average consumption across the four measured months and multiplying it by the total number of working

	days in a year. Public holidays were not considered in this assumption.
Description of 1st order effects	The first-order effects of the Colt Smart Building solution are related to the direct environmental impacts arising from the deployment and operation of the system's components. These include the embodied emissions, use-phase emissions, and end-of-life emissions of the hardware, as well as the emissions from cloud computing resources. Four categories of components are considered for this solution: **1) Network Appliance (Advantech FWA3260A)** • Emissions include use-phase electricity consumption during operation (annualized), embodied emissions from production, and end-of-life treatment (annualized). **2) Cloud Storage (Azure Cloud Platform)** • Emissions are allocated based on Colt's share of Nuuka's cloud storage usage; emissions values related to the cloud storage has been provided by the solution's vendor. **3) Sensors (IoTSU – 26 for temperature & humidity, 4 for differential pressure)** • Only embodied and end-of-life emissions are considered since the sensors are battery-powered, and their use-phase electricity consumption is excluded. **4) Access Point (Gateway for LoRa Technology)** • Emissions include use-phase electricity consumption, embodied emissions from production, and end-of-life treatment.

Description of 2nd order effects	The 2nd order effects of the solution are the decrease in electricity consumption by the ventilation system fans as a result of the AI platform minimising fan speeds while maintaining a minimum required air quality. The avoided emissions mechanism is achieved by reducing electricity demand for HVAC operations, thereby lowering the associated CO_2 emissions from electricity generation.
Description of higher order effects	By continuously monitoring indoor air quality parameters and adjusting HVAC operation accordingly, the system helps ensure a healthier indoor environment. Improved air quality and optimized working conditions, particularly with respect to temperature and humidity, contribute directly to occupant's well-being and comfort. At the same time, the reduction in unnecessary energy use leads to significant cost savings for the building operator, reinforcing the business case for implementing the solution. Improved working conditions and indoor environments may contribute to higher occupancy rates in office buildings, as employees are more likely to use spaces that feel comfortable and healthy. The dynamic control of HVAC systems could also result in shifts in energy demand, for example when changes in fresh air intake alter consumption patterns. Finally, the behaviour of building occupants remains an unpredictable factor; actions such as frequently opening windows or interfering with HVAC operation may influence the efficiency and overall results of the system. Please note that all possible higher order effects are as of now assumed and have not yet been proven.

Mapping of 2nd order and higher order effects



Assessing the impact of higher order effects

Effect	Quantitative assessment	Magnitude	Likelihood	Mitigation
Cost savings due to reduced energy consumption	**Energy Savings kWh/year:** 32,705 **Cost of electricity in UK ($/kWh):** $0.32 **Cost ($/kWh):** $10,465.64 **EIO factor OPEN CEDA:** 0.126 kgCO2e/$ (Satellite, telecommunications, and all other telecommunications – UK - Link) **Emissions:** 1.31 tCO2e per year	20% of total carbon savings enabled by solution therefore high risk	Highly likely unless these cost savings are ring fenced for specific activities.	Colt and Nuuka are exploring how they can ensure that cost savings are re-invested to further reduce emissions rather than into carbon intensive activities: • **Reinvest into HVAC and systems upgrades.** Savings can be allocated into renovating existing assets — e.g. new fans, variable speed drives, heat recovery modules, improved controls. Over time, this lifts the efficiency baseline and enables further optimization gains. • **Improve NOI and valuation.** Lower energy and maintenance costs reduce OPEX, increasing net operating income (NOI). That boosts the building's yield, compresses cap rates, and raises valuation — all without having to raise rents immediately. • **Protect rental income via occupant well-being.** Consistently healthy indoor climate (temperature balance, air quality, humidity) enhances tenant satisfaction, reduces complaints and turnover, and supports stable rental revenue. • **Reduce maintenance burden and failure risk.** With predictive diagnostics, maintenance becomes smarter and leaner. Nuuka's customers say 50–75 % gains in efficiency with fewer reactive fixes, reduced downtime, and extended asset life.

Description of calculation	**1st Order Effects** The solution emissions are calculated by summing the annualized embodied emissions, annual use-phase emissions, and annualized end-of-life emissions of all hardware, as well as emissions related to the use of Azure's cloud solution.

	Emissions from the cloud platform have been provided by the service provider (Microsoft) to Nuuka. The share of Nuuka's storage attributable to Colt's solution was allocated based on the number of data points generated. Use-phase emissions are calculated from the annual electricity consumption of each device multiplied by the relevant emission factor for the electricity grid. No use-phase emissions have been considered for sensors, as they are battery-powered. Embodied emissions account for the contributions from materials used in device components, divided by the expected lifetime of the device. End-of-life emissions are calculated by multiplying the weight of the device or sensor by the relevant waste emission factor and dividing it by the device's lifetime. Total first-order emissions are obtained by summing up the contributions from all devices and the cloud platform, including embodied, use-phase, and end-of-life emissions. **2nd Order Effects** The second-order effects represent the emissions avoided due to reduced energy consumption in the AHU (fans) after implementing the solution. They are calculated as the difference between the baseline annual electricity emissions before the solution and the annual electricity emissions after the solution is in place. This captures the operational energy savings achieved by the system. **Net Carbon Impact** Net carbon impact is calculated by subtracting the first-order emissions generated by the solution itself from the 2nd order effects. This ensures that the environmental benefit accounts for the emissions embedded in the solution components and cloud usage, providing a more accurate measure of the net reduction in greenhouse gas emissions.

Net Carbon Saving Impact of the Solution	**Ventilation System – Annual Impact** 1st order effect (emissions from solution components): • 0.3 tCO2e/year 2nd order effect (avoided emissions from reduced energy use): • -9 tCO2e/year Total net carbon saving impact: • -8.7 tCO2e/year **Other Savings from reference scenario:** % Energy savings through use of the solution: • 35% CO2 emissions reduction per square meter of office space: • -1.2 kgCO2e/m^2/year
Uncertainty and sensitivity analysis	**Total carbon savings enabled (tCO_2e):** Calculated Net Avoided Emissions: -8.7 Lower uncertainty range: -6.1 Higher uncertainty range: -12.3 **Uncertainty analysis:** Electricity consumption is the main driver of uncertainty. In the ranges assessed, electricity-related emissions (2nd order effects) vary from 6.2 tCO_2e to 13 tCO_2e, Cloud storage activity is the second most sensitive input. Emissions rise from 26.9 (lower range) to 51.5 $kgCO_2e$ at the higher range. Network appliance and gateway embodied emissions also show moderate variation. Network appliance-related emissions increase from 93.4 $kgCO_2e$ at the lower range to 225.9 $kgCO_2e$ at the

	higher, while gateway emissions range from 16.1 $kgCO_2e$ to 38 $kgCO_2e$. Sensor embodied emissions remain immaterial, increasing to 6.5 $kgCO_2e$ at the higher range.
Assumptions	**Bill of Materials and Component Weights** • The weights of individual components have been assumed based on available specifications for comparable products. • Where exact data was not available, the Bill of Materials (BOM) was estimated, and missing values were calculated by deducting known component weights from the total product weight (e.g., chassis, plastics). • All sources and technical references used for these assumptions are stored within the calculator and can be consulted if needed. **Performance and Efficiency** • Power supply efficiency has been assumed at 82%, reflecting average performance of commercial power supplies. **Lifetime of Devices** • When the lifetime was specified in the product sheet, that value was used. • When lifetime information was not available, an assumption was made based on comparable devices, with all references and justification available in the calculator. **Estimation Methodology** • For missing weight data, values were back-calculated by deducting known components from the total product weight. • For cables, a rough estimation has been applied in the absence of detailed specifications. • All assumptions regarding hardware components and BOM are based on secondary data sources available in the calculator. **Operational Assumptions**

	• Energy consumption calculations were extrapolated by dividing the reported consumption by the number of working days (Monday–Friday). • Multiplying daily values by the number of working days in a year, for the purpose of this assumption, bank holidays were excluded, as the exact mode of building operation during those was unknown **Emissions** • For the cloud solution, emissions data is based on primary data provided by the supplier to Nuuka. • The supplier-provided information was assumed to be of a better quality than achieved by using secondary data.
Data sources	**Data provided by Colt:** • Data request form - Colt Smart Building Solution-8Aug2025 with data.xlsx **Data Sheets for the solutions's components**: • IOTSU® AQ Combo for LoRaWAN® - product specification • IOTSU® DP for LoRaWAN - product specification • MultiTech Conduit®AP Access Point for LoRa® Technology EU868 Models - Product Specification • FWA-3260 – product specification **Raw Data** • COLT-AHU-ReferenceVsActual_RAW.xlsx **Secondary data sources:** All secondary data sources used during calculations of the 1st order effects have been linked within the calculator **Cloud storage - Microsoft data** Data shared via e-mail: Re Colt Smart Building Solution - Case Study - Microsoft data.msg
Input adjustments and key considerations for usage of results	**List of things to consider if using results in other use cases:** • Country (for the electricity grid) • Office Location • Building type • Surface area of the office building (m2) • Reference Scenario Energy Usage • Data period for a reading

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'Do no significant harm' criteria	Do not foresee any negative impacts on any of the EU Taxonomy's environmental nor social objectives and strongly supports objective 1. Climate change mitigation. The Colt's Smart Building solution is scalable, while also having the potential to improve quality of life and human comfort.
Key areas for improvement	1. Extended measurement period for electricity consumption, currently it's only 4 months which may not be representative across a full year. 2. Collecting primary data for the reference scenario's electricity consumption to validate the hypothetical model.

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