

White paper – Measuring the IT footprint

Our journey to identify, calculate and dashboard
the IT Carbon Footprint @ABN AMRO

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From implementing measures to measuring impact

Since the publication of the Manifest Sustainable Digitalisation in 2022, the National Coalition for Sustainable Digitalization (Nationale Coalitie Duurzame Digitalisering, NCDD) has worked together with government, industry, academia, education and civil society to accelerate sustainable digitalisation in the Netherlands. The coalition has helped organisations move to awareness and from awareness towards action by developing practical tools, knowledge products and communities around sustainable IT.

In recent years, more and more organisations are taking important first steps. In some organisations sustainable IT has become part of digital strategies, procurement policies, cloud migration programmes, software development practices and enterprise architecture. Through the NCDD, organisations have jointly developed practical guidance such as the Sustainable IT Impact Assessment (SIIA), sustainable procurement guidelines, GreenOps frameworks, enterprise architecture principles, circular IT roadmaps and practical knowledge sharing between frontrunners.

These developments mark an important transition. Sustainable IT is no longer only about identifying opportunities or implementing isolated measures: organizations are entering a new phase of maturity in which they ask themselves a different question:

Are our measures actually delivering the intended environmental impact?

Answering that question requires organisations to move from implementing measures towards measuring outcomes and setting targets: into a new maturity phase.

A new maturity phase

The NCDD increasingly sees organisations entering a new phase of maturity.

The first phase focused on identifying improvement opportunities: extending hardware lifetime, improving procurement, adopting GreenOps practices, optimising software, improving data management, reducing unnecessary digital consumption and embedding sustainability into governance.

In the next phase organisations need reliable information that enables them to understand where the environmental impact of IT occurs, compare interventions, steer investments, monitor progress, comply with reporting requirements and communicate transparently with stakeholders.

The next maturity phase is about measurement, steering and continuous improvement.

Why measuring IT sustainability is difficult.

Modern digital ecosystems consist of public cloud, SaaS, AI services, on-premises infrastructure, software supply chains, end-user devices and outsourced development. Many components are supplied by international vendors using different methodologies and reporting practices.

As a result, organisations face inconsistent accounting methods, limited supplier transparency, incomplete Scope 3 information, rapidly evolving AI workloads and fragmented standards. Measuring sustainable IT therefore becomes an organisational capability rather than simply a reporting exercise.

Learning from frontrunners: the ABN AMRO use case

Within the NCDD, several organisations have progressed beyond implementing sustainable IT measures and have started building integrated measurement capabilities.

ABN AMRO is one of these frontrunners. Over the past several years the bank has developed a practical approach to measuring the environmental footprint of its IT landscape by integrating cloud services, data centres, workplace devices, software, suppliers, AI and business processes into one coherent management framework.

The purpose is not simply to calculate emissions, but to support better decision-making through identifying hotspots, prioritising interventions, monitoring progress, establishing baselines, defining targets and improving governance.

Next steps for the NCDD

The lessons from this white paper are many. We tried to summarize those lessons and next steps in part 5, “Findings and conclusions”. For the NCDD the following next steps are particularly important:

1. The NCDD should enable knowledge sharing and scaling of best practices, such as the ABN AMRO use case.
2. This facilitates alignment of measurement approaches and definitions, for example by collecting and sharing the practices of the members of the NCDD.
3. By discussing these practices within the NCDD, consensus grows about the best practice. Consensus then enhances the adoption and development of (inter)national standards and policies that fit these practices.
4. When consensus grows on how to measure the Carbon Footprint, the NCDD can influence suppliers to provide this data.
5. Consensus on and adoption of best practices leads to comparability. Comparability is an important driver for organizations and service providers to reduce the carbon footprint of IT effectively.

White Paper: Measuring the IT Carbon-Footprint at ABN AMRO

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Preface ABN AMRO

This white paper shares the practical experience gained by [ABN AMRO](#) in developing a capability on measuring its IT carbon-emissions. The paper introduces measurement principles, protocols, methodologies, service providers, data sources and dashboarding. The paper continues with related topics like governance, target setting, reporting and concludes with reflections and lessons learned.

The paper focusses only on the carbon emissions, associated with the use and operation of IT assets and IT services at ABN AMRO, and briefly touches upon the challenges of measuring GenAI.

We understand the total IT sustainability challenge is wider than carbon emissions with other impacts like use of land, water, (scarce/polluting) materials, biodiversity loss or the social aspects of manufacturing and running IT / circular.

We do not pretend to have found the holy grail of 'measuring' but consider our setup a best practice of an early practitioner in this field. By sharing our approach and journey we aim to help other organisations get started or move faster on this increasingly important topic.

Throughout the paper, the NCDD ([National Coalition for Sustainable Digitalization](#)) highlights in grey the common challenges and opportunities for collective action: directly related to the approach and experiences of ABN AMRO.

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Introduction

This paper shares the experiences gained over the past years within ABN AMRO, to measure Carbon footprint of our IT.

The intent of this document is to:

- Provide an entry point for organizations who want to measure their IT footprint.
- Acknowledge methods, protocols and norms that can or have to be applied.
- Define categories for dashboarding your IT footprint.
- Setting Baselines and Targets
- Introduce related subjects you may typically run into
- Share a reflection on our (ABN AMRO) journey so far.

Since we recognize the challenge of how to measure the footprint of IT, we hope this will assist other organizations in their efforts and journey. We embarked in 2020 to find the right approach, data and methods to capture the footprint of IT as not much guidance was out there at that stage.

Today we have captured our IT footprint metrics in an overarching dashboard, but the journey has not finished. New technologies are released, datapoints disclosed, methods developed and services delivered, so we continually have to assess what to adopt and where it improves our outcomes and overall maturity.

Finally, this document is written in an open, accessible and pragmatic way, based on theory and practical experiences, supplemented with additional and relevant sources that provide background or provide direction to more information.

Reading guide: for most topics this paper follows the same three steps. First the background, the general methods, standards and concepts that apply to any organization. Then the ABN AMRO journey, the choices we made and the dilemmas we ran into. And finally, the NCDD findings, what this means for the sector and where a coordinated national effort can help. When a topic is worked out in more detail we point to the appendices.

The importance of measuring the IT Carbon Footprint.

Credible claims and transparency around sustainability actuals, trends or achievements need to be underpinned with valid data via unified and validated frameworks and calculation methods.

This need for transparency is also often addressed in the media, an example below.

WITOLD KEPINSKI - 10 NOVEMBER 2025

Deel dit artikel

Zonder de juiste cijfers blijft groene IT een illusie

Bedrijven die gebruik maken van rekenkracht en dataopslag in de cloud en hun IT willen vergroenen, moeten wel weten waar winst te behalen is. Cloud-aanbieders delen vooralsnog echter niet alle cijfers over energiegebruik en CO₂-uitstoot, en doen dat bovendien elk op een andere manier. Dit schrijft Julia Krauwer, sector banker TMT bij ABN AMRO Sector Expertise.

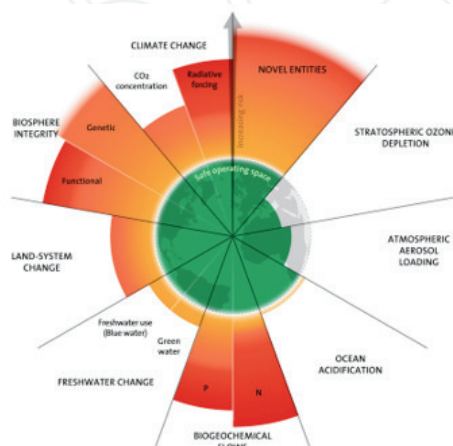
Source: [Dutch IT Channel - Zonder de juiste cijfers blijft groene IT een illusie](#)

Scope of this paper: Carbon footprint of IT

This paper is about measuring the carbon footprint of IT. Topics that may look separate are included only where they translate into emissions: IT Asset Disposition (ITAD), for example, is addressed, because assets contain embodied carbon. Other impacts that are just as real – such as freshwater and land use, materials and social implications – fall outside the scope of this measuring paper. We mention them so it is clear what we do and do not cover.

Are IT energy use and associated carbon emissions material?

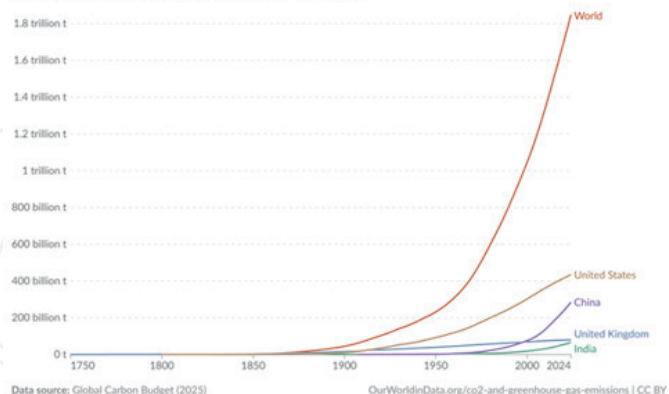
Our world is under environmental pressure, our (IT) consumption, associated energy use and carbon emissions creates severe impacts like climate change from CO₂ emissions, exceeding planetary boundaries and risking tipping points beyond which the effects can no longer be reversed.



Planetary boundaries - Stockholm Resilience Centre

Cumulative CO₂ emissions

Running sum of CO₂ emissions produced from fossil fuels and industry^a since the first year of recording, measured in tonnes. Land-use change emissions^a are not included.



Data source: Global Carbon Budget (2025)

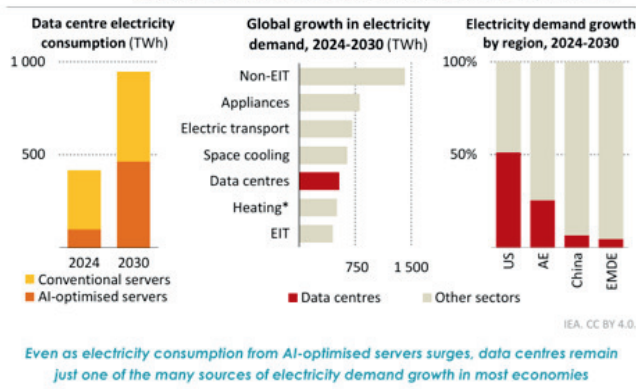
OurWorldinData.org/co2-and-greenhouse-gas-emissions | CC BY

CO₂ emissions - Our World in Data

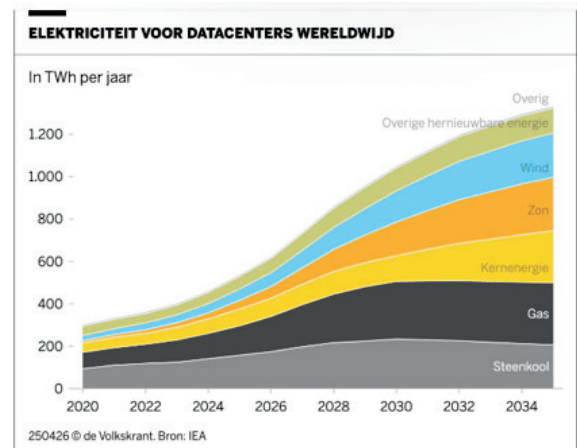
The IT sector by now is part of those environmental problems: the IT footprint is rising rapidly and has become material.

For example: the statistics below from the IEA outlook show the growing share of datacentres in the world-wide increase in energy demand. But IT impact sits also in categories like end user devices (laptops/tablets/screens) or higher up the supply chain in the asset manufacturing, materials processing and excavation. The GenAI developments are accelerating the emissions of IT especially where they are fuelled by gas/coal turbines.

Figure 1.16 Electricity consumption in data centres by server type, and global and regional electricity demand in the STEPS, 2024-2030



[World Energy Outlook 2025](#) and IEA/Volkskrant

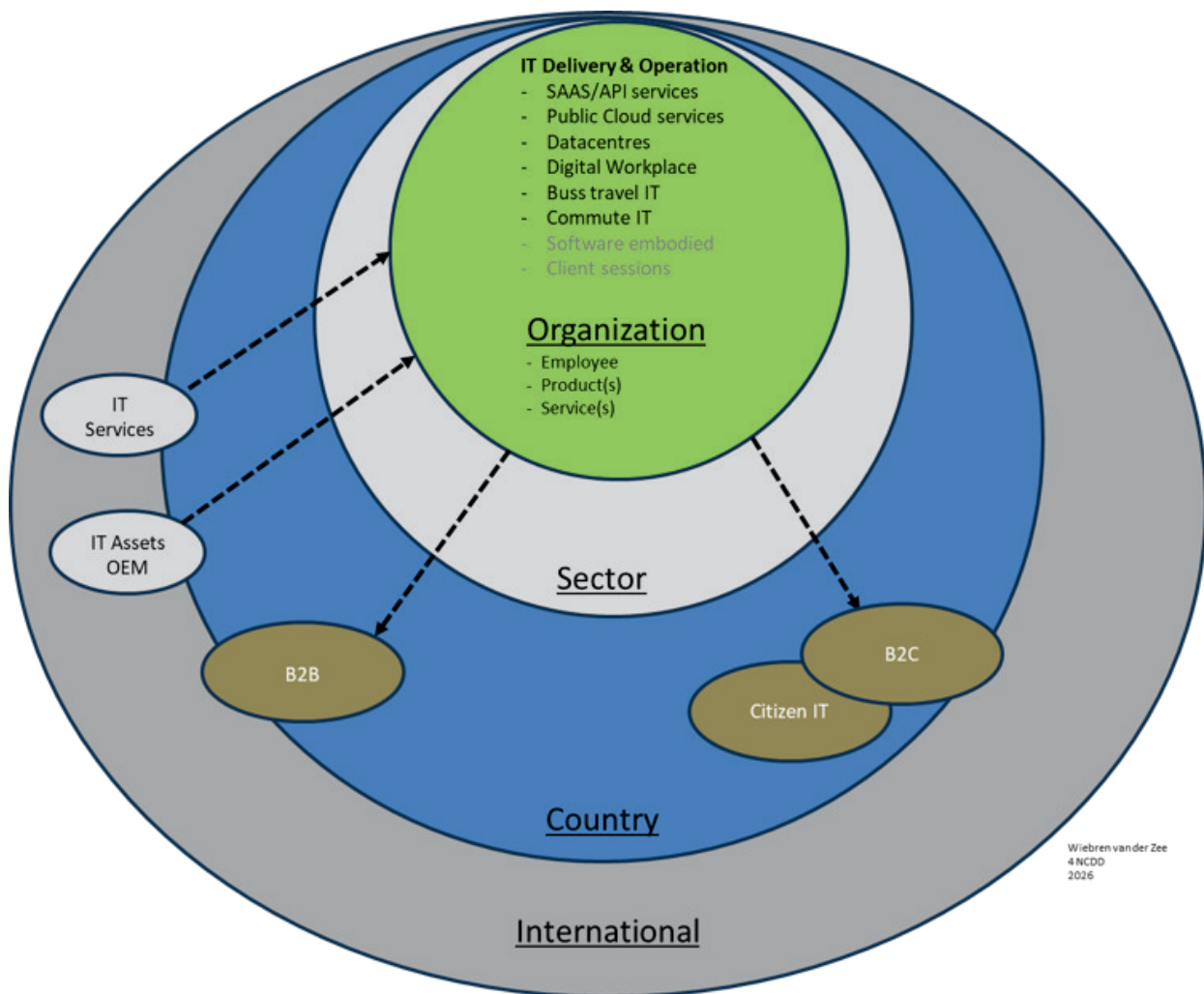


Different perspectives

This paragraph is an assessment of the different ways IT systems of a large organization contribute to the footprint.

We can take different perspectives when we determine the impact of IT. For this paper we will limit ourselves to the organization context. An organization operates in a sector, can have all sizes and contain a commercial or institutional character. Its IT supply chains, products and services typically are extensive and consist of hardware, software development and (support) services.

Other perspectives are possible like on a country level, sector level or for example a 'home workplace' viewpoint (see earlier [publication](#) by the NCDD).

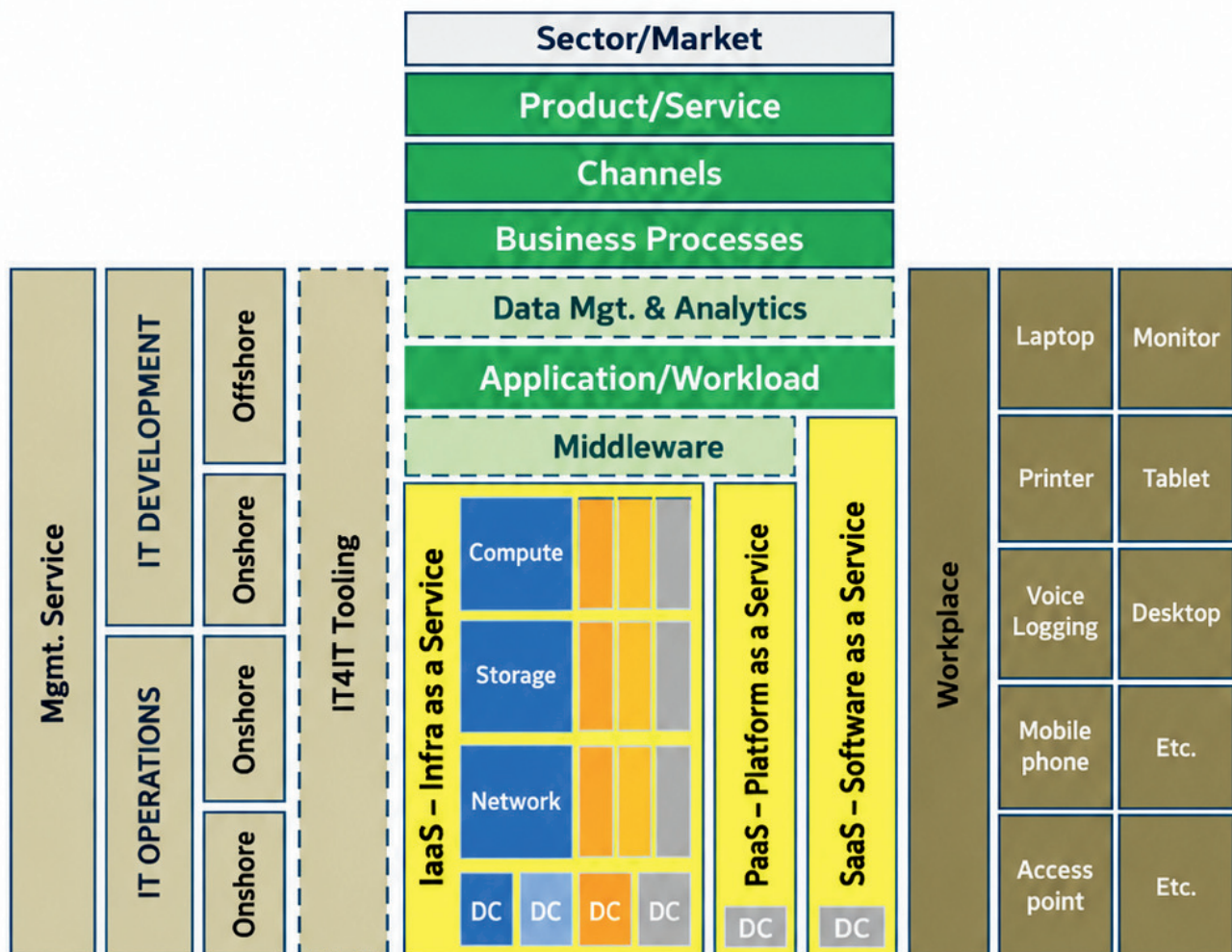


IT landscape model

For the ABN AMRO organization we originally started on the model below to depict where our IT footprint would typically be applicable, acknowledging the IT backend (Datacentre services via IAAS/PAAS/SAAS deliveries), IT frontend equipment (end user devices) and finally the IT operating model with professionals working on application development, maintenance and operations, either onshore or offshore.

The different categories can be found in our sustainable IT dashboard (see part 2).

IT Landscape model



Legend – IT landscape model

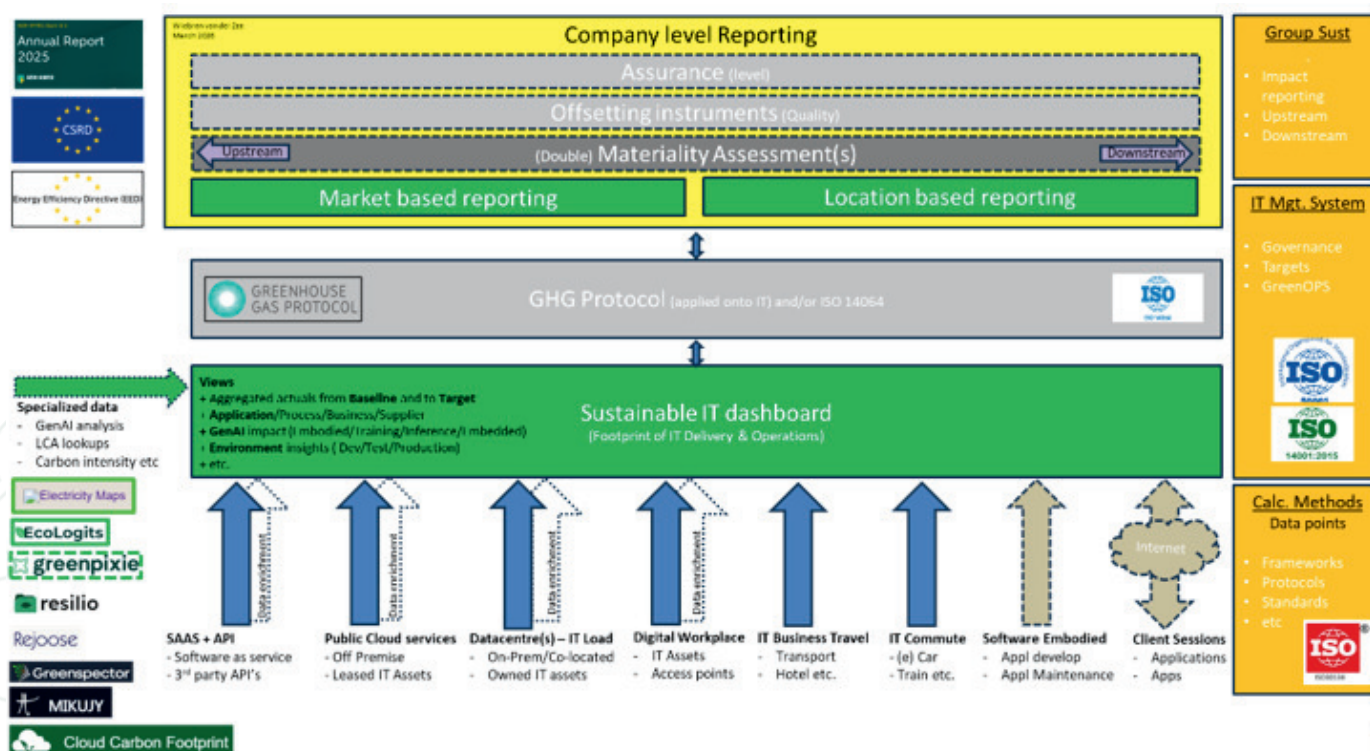
- Green – Business and application landscape.** Business-facing and software layers, ranging from products, services and channels to business processes and application workloads.
- Light green / grey – Shared platform capabilities.** Enabling layers that support applications and workloads, such as data management, analytics and middleware.
- Yellow – IT service delivery models.** Infrastructure, platforms and software delivered as a service: IaaS, PaaS and SaaS.
- Blue – On-premise / internally managed infrastructure (tentative).** Compute, storage and network resources hosted within the organisation's own or directly managed data-centre environment.
- Orange – Externally hosted / public-cloud infrastructure (tentative).** Compute, storage and network resources provided through external hosting or public-cloud environments.
- Brown – IT operating model.** The organisational surrounding the technology stack, including IT operations, IT development, IT4IT tooling, and connectivity.
- Khaki – Digital workplace.** The end-user environment of workplace devices.
- White – Industry context.** FSI (Financial Services Industry) represents the sector in which the IT landscape of ABN AMRO operates.

The colour coding visually separates the business and application layers, shared technology capabilities, service delivery models, infrastructure environments, and the operating and workplace environment.

NCDD: a widely applicable generic model, to describe the sources of carbon emissions. The NCDD can take this further, either by developing a shared model or by positioning the ABN AMRO case as a reference example for other organizations. The model can be used to compare organizations and the effectiveness of measures to steer carbon emissions. The model should be suitable to describe the emissions of small and large organizations.

Overarching (Reference) Model

Measuring and dashboarding is necessary to track and trace your IT impact, to let you take responsibility and set goals for improvements and/or compliance. The model below aims to summarize the setting of a Sustainable IT or 'GreenOPS' practice within an organization that aims to identify, report and manage its IT footprint.



Legend – Sustainable IT measurement, goal setting and reporting model

- Green – Core measurement and reporting.** Components in which IT footprint data is consolidated, analysed and reported, the **Sustainable IT dashboard** and **market-based and location-based reporting**.
- Grey – Accounting, assessment and assurance framework.** Standards and control layers used to calculate, qualify and validate the footprint, including the GHG Protocol / ISO 14064, materiality assessment, offsetting and assurance.
- Yellow / amber – Governance and company-level context.** Organisational structures around the measurement process, including **company-level reporting, sustainability governance, IT management systems and calculation methods**.

-  **Blue arrows – Primary data flows.** operational and IT data feeding the Sustainable IT dashboard.
-  **Blue arrows with white overlay – Data flows requiring enrichment.** Primary data that needs additional information, allocation factors or calculation data before it can be translated into footprint metrics.
-  **Light beige arrows / Internet symbol – Data flows (tentative).** Additional categories for Software embodied (upstream) and Client sessions (downstream).
- **Provider logos on the left – External data and calculation sources.** Examples of tools and providers supplying carbon-intensity data, emission factors, software measurements or other sustainability data.
- **Reporting and regulatory logos – External reporting requirements and frameworks.** Examples include the Annual Report, CSRD and the Energy Efficiency Directive (EED).

The model shows how operational and external data is brought together in the Sustainable IT dashboard, translated into GHG-accounting information, and subsequently used for market- and location-based reporting and company-level sustainability reporting.

NCDD: a shared reference model how measurement, goal setting and reporting are related, is important - a candidate for NCDD guidance.

In the previous chapters we presented a model to describe the IT landscape, from the perspective of emission sources. We developed a model to relate measurement, steering and accountability.

Methods, protocols, norms and emerging standards

This paragraph focuses on actual measurement. Before moving to the measuring methods some concepts need a short introduction.

First: the footprint of all IT categories in the previous paragraph will be categorized in terms of GHG scope 1, 2 and 3 associated footprints. What those footprints entail is explained in the GHG model below.

GHG Protocol

The [Greenhouse Gas Protocol \(GHG Protocol\)](#) is the world's most widely used greenhouse gas accounting standard, providing frameworks for businesses, governments, and organizations to measure, manage, and report emissions. It categorizes emissions into three scopes (1, 2, and 3) to promote consistency and transparency in climate action and emissions reduction.

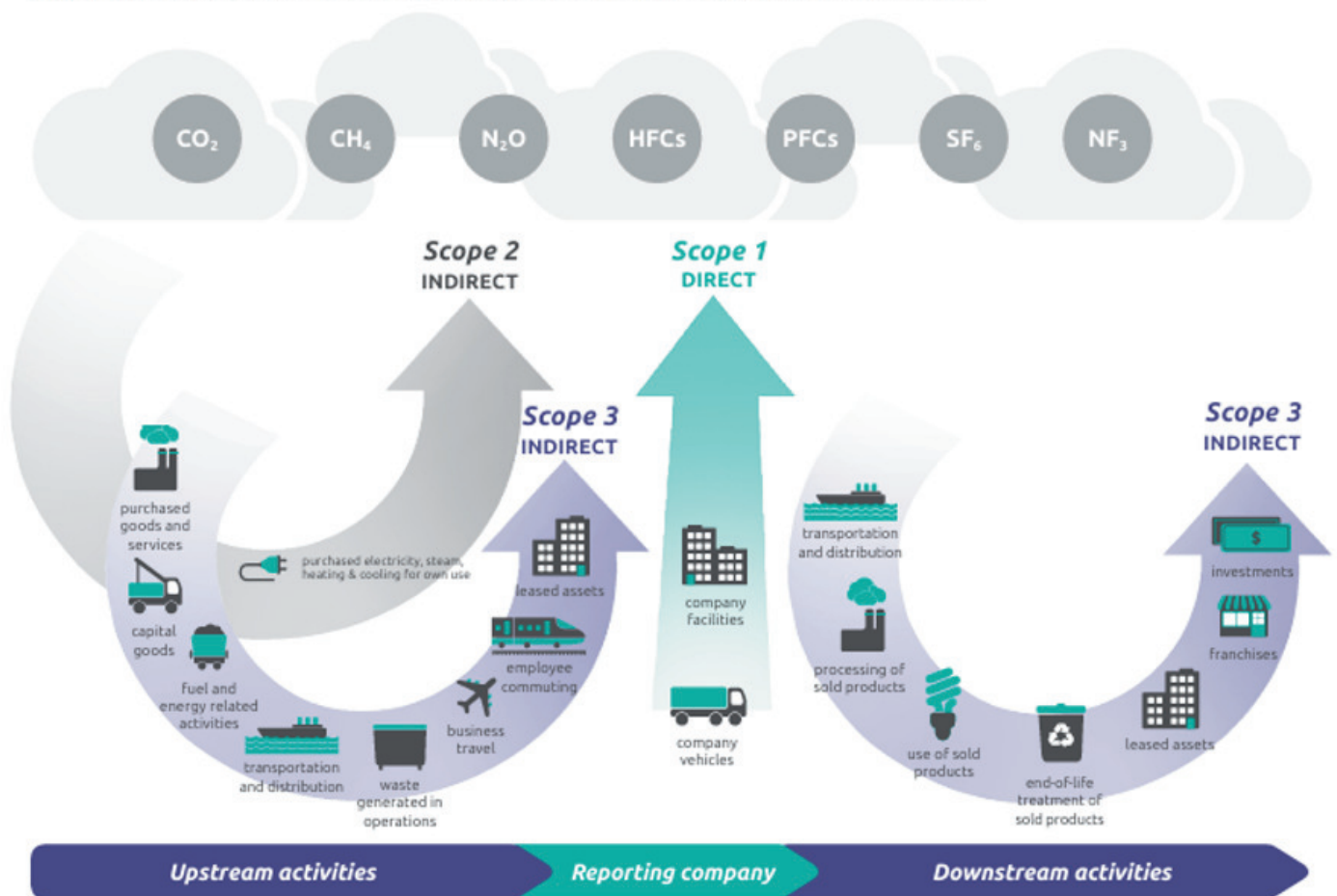
Scope categorization

The GHG Protocol categorizes corporate greenhouse gas emissions into three scopes:

- Scope 1: Direct emissions from sources owned or controlled by the organization.
- Scope 2: Indirect emissions from the generation of purchased electricity, steam, heating and cooling.
- Scope 3: All other indirect emissions occurring in the organization's value chain, both upstream and downstream.

This categorization provides a common structure for measuring and reporting emissions and supports consistency and transparency between organizations.

Figure [1] Overview of GHG Protocol scopes and emissions across the value chain



Source: Figure 1.1 of Scope 3 Standard.

Source/More information: [Homepage](#) | [GHG Protocol](#), [GHG Protocol or ISO 14064 - Which standard to choose?](#), revision is underway: [Scope 3 Standard Revisions Phase 1 Progress Update](#), [Scope 3 Calculation Guidance](#) | [GHG Protocol](#)

Figure: Overview of GHG Protocol scopes and emissions across the value chain.

The figure shows the reporting company in the middle of a broader value chain. Scope 1 represents emissions directly generated by the company, for example from company facilities and vehicles. Scope 2 covers the emissions associated with purchased energy.

Scope 3 extends beyond the organization itself and covers emissions occurring both **upstream**, before products and services reach the organization, and **downstream**, after they leave the organization.

An important point is that emissions can appear in different scopes for different organizations. The Scope 1 or 2 emissions of a supplier can, for example, become Scope 3 emissions in the inventory of the customer buying that supplier's product or service. This is also one of the reasons why measuring Scope 3 depends heavily on information from suppliers and other parties outside the organization.

Keep actual, avoided and compensated emissions separate.

Scope 1, 2 and 3 represent emissions attributable to the organization and its value chain. Avoided emissions (often referred to as scope 4) are sometimes disputed and should be accounted for separately and not be used to reduce the Scope 1, 2 or 3 inventories.

An organization can compensate for emissions through measures outside its own inventory, for example through carbon credits or projects that remove or avoid emissions elsewhere. Such measures may compensate for emissions, but they do not change the amount of Scope 1, 2 or 3 emissions reported in the inventory itself.

It is therefore important to keep *actual emissions*, *avoided emissions* and *compensated emissions* separate. This prevents avoided or compensated emissions from being used to reduce the reported Scope 1, 2 and 3 footprints, while still allowing their wider climate contribution to be made visible.

Avoided and compensated emissions are discussed later in this paper in the chapter on *Offsetting* in part 4.

A following paragraph introduces another key accounting distinction: *market-based versus location-based reporting*.

A Scope 3 breakdown into categories

Scope 3 itself is not one single emission source. To make the value chain manageable, the current GHG Protocol divides Scope 3 into 15 categories: eight upstream and seven downstream categories.

The upstream categories cover emissions associated with activities before goods and services reach the reporting organization. These include purchased goods and services, capital goods, fuel- and energy-related activities, transportation and distribution, waste

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The downstream categories cover activities after products or services leave the reporting organization. These include downstream transportation and distribution, processing and use of sold products, end-of-life treatment, downstream leased assets, franchises and investments. For the purpose of this paper, we take only the IT supply chains into account.

THE 15 SCOPE 3 CATEGORIES

Category	Direction	Examples
1. Purchased goods & services	↑ Upstream	Raw materials, outsourced manufacturing
2. Capital goods	↑ Upstream	Equipment, machinery, buildings
3. Fuel & energy activities	↑ Upstream	Upstream emissions from purchased fuels
4. Transportation & distribution	↑ Upstream	Inbound logistics, third-party transport
5. Waste in operations	↑ Upstream	Landfill, incineration, recycling
6. Business travel	↑ Upstream	Air travel, hotels, rail
7. Employee commuting	↑ Upstream	Staff travel to and from work
8. Leased assets	↑ Upstream	Emissions from leased facilities
9. Transportation & distribution	↓ Downstream	Outbound logistics to customers
10. Processing of sold products	↓ Downstream	Customer manufacturing
11. Use of sold products	↓ Downstream	Consumer use of final products
12. End-of-life treatment	↓ Downstream	Disposal, recycling
13. Leased assets	↓ Downstream	Assets leased to others
14. Franchises	↓ Downstream	Scope 1 & 2 of franchisees
15. Investments	↓ Downstream	Financed emissions

Figure: The 15 Scope 3 categories, divided into upstream and downstream activities. Source: Net0, based on the GHG Protocol Scope 3 categorization. [AI Blog for Governments and Enterprises | Net0](#)

The categories help to identify where emissions occur, but also where the required data has to come from. Different categories will typically require different sources and calculation methods. Where primary data is not available, organizations may initially have to work with estimates: for example, using spend-based (see following paragraph) or average-data/market-data approaches, gradually moving to more supplier-specific data.

ABN AMRO

For our own IT Operations, we acknowledge the categories of 1. Purchased goods & Services, 2. Capital goods (embodied carbon), 6. Business travel, 7 Employee commuting and 12. End-of-life treatment (ITAD) are found most material. Category 15 –

Investments may seem also relevant, yet these financed emissions are not allocated to the own (IT) operations! Also the enabling effects of IT — such as fewer paper statements or reduced building and travel emissions through internet banking — have not (yet) been quantified; such avoided emissions fall outside the Scope 1–3 inventory and would be reported separately as avoided emissions.

Revision of the Scope 3 Standard is underway.

The GHG Protocol is currently revising this standard. In March 2026 it published a Phase 1 Progress Update describing the direction of a number of proposed revisions. The basic structure shown in the first figure remains to a large extent the same. The proposed revisions focus, amongst other things, on data quality, inventory boundaries and the classification of investments. They include more explicit disclosure of the type of data used, verification status and recommendations to improve data quality over time.

A significant proposed change concerns the boundary of the Scope 3 inventory. Under the draft revision, companies should include at least **95% of total required Scope 3 emissions — This is a material change: for service organisations, purchased goods and services will more often exceed the 5% threshold and must be reported.** Exclusions would be limited to less than 5%.

Another proposed change is a new category: Category 16 – Other value chain activities. It is for activities that do not fit adequately within the existing Categories 1 to 15. This proposed category would include facilitated emissions: emissions generated by third-party activities from which the reporting company earns direct transactional income without buying, selling or owning the underlying activity.

At the same time, the proposed revision narrows Category 15 – Investments so that it contains only investments: financed emissions. Other financial activities and services, including insurance and underwriting move to Category 16.

For this paper the 15-category model remains the reference point.

NCDD: The NCDD could typically track the protocol modifications and help (large) IT users apply this method as part of the reporting standard

When to use which measurement method (in scope 3): estimations, averages and supplier specific data.

The GHG protocol provides guidance when to use what method (in scope 3). The decision tree below has been taken from the GHG protocol and helps to identify the right approach. With data sources ranging from Supplier specific data to Spend based proxy estimations.

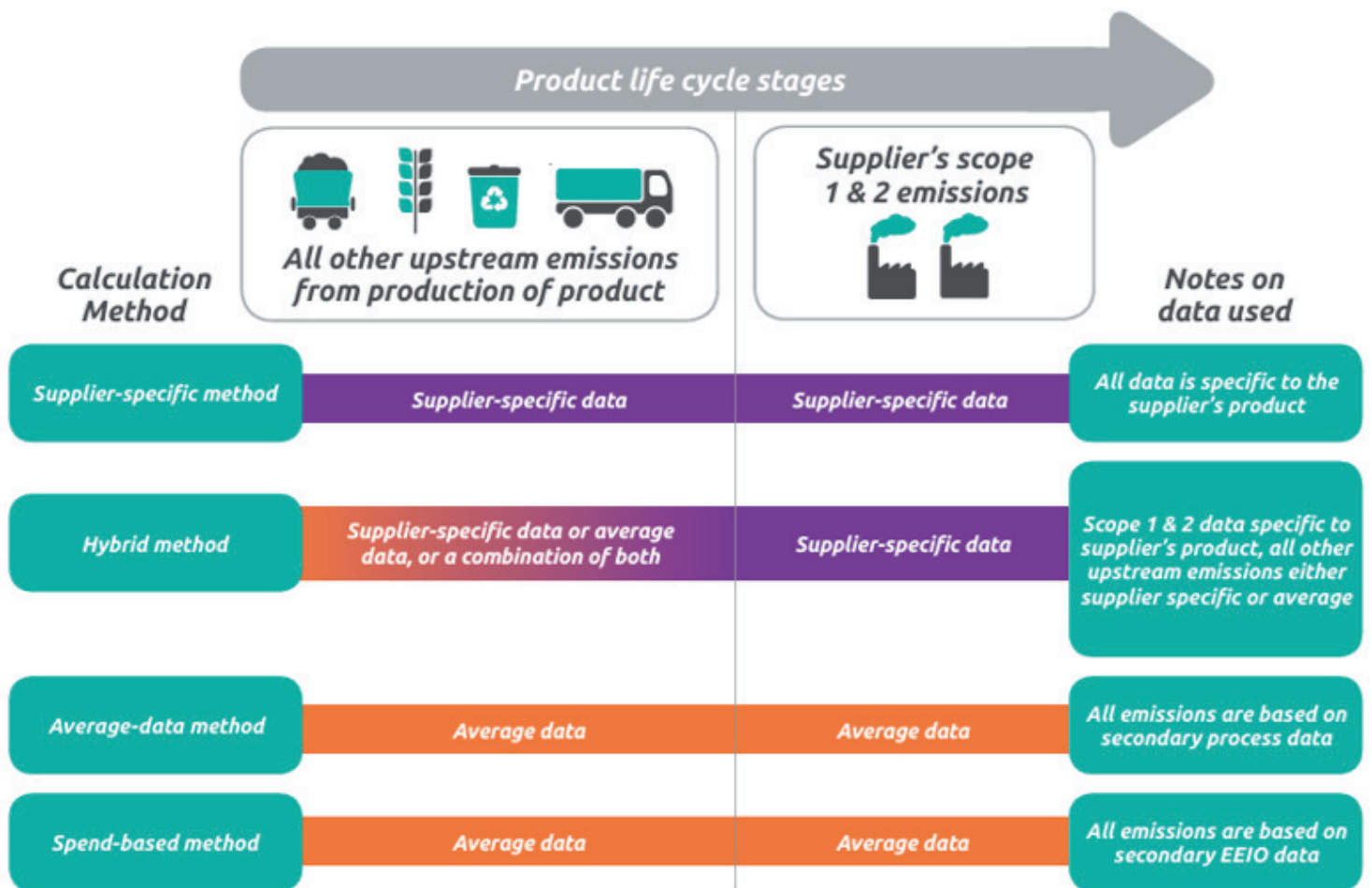
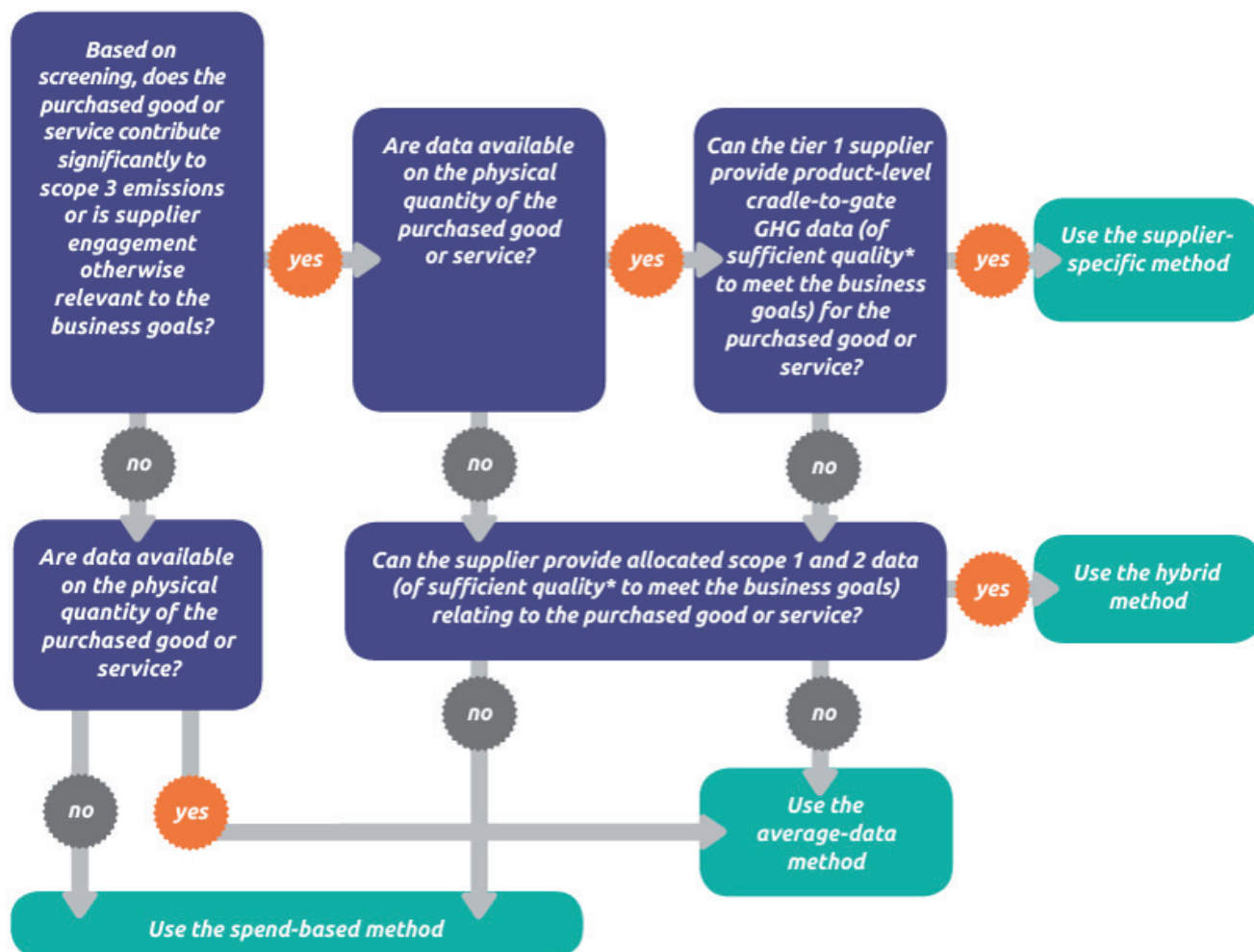


Figure [1.2] Decision tree for selecting a calculation method for emissions from purchased goods and services



More information/Source: [Chapter1.pdf](#), [Scope3 Calculation Guidance 0\[1\].pdf](#), [How can I fill the Gaps?](#)

ABN AMRO

For our current dashboard we have used a mix of the calculation methods whereby we typically started with the spend-based method if no data was available and moved via market-based data towards more primary (supplier) data once available.

A clear demand from the sustainable IT team, procurement and/or the related IT product owner to the suppliers (OEMs) is often necessary to obtain the right (quality of) data. An important side-effect relates to the internal teams within the Suppliers organization, since it helps them to show that their customers, like ABN AMRO, are actually demanding and using this data.

NCDD: the supplier-specific data these methods rely on is a key challenge for the sector: bundling demand from Dutch organizations would help make it available.

Market based vs Location based Realities (Scope 2)

Reporting typically acknowledges 2 realities, Market based and Location based Carbon, the differences are stated below.

Location-Based Reporting

This method reflects the actual Grid Carbon Intensity **where a company's operations are running**.

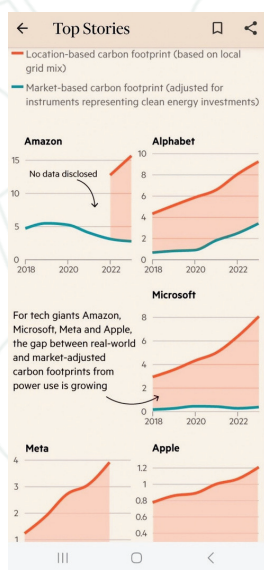
- It doesn't matter what energy has been purchased or offset elsewhere
- It uses public data about regional energy mixes e.g. the UK's National Grid
- It tells you the real-world carbon impact of using electricity in a specific place

Location-based reporting shows the real carbon emissions associated with powering a company's operations based on physical energy generation.

More information: [Market-Based vs. Location-Based Electricity Emissions - CarbonBetter](#)

These 'realities' are relevant to understand, as market-based calculation should not be mixed with location-based calculations to keep outcomes correct. When a carbon figure is calculated or reported it has to be clear on which of both realities the calculation is based on.

The graphs shown here in an article published by the Financial Times indicate the big difference between both realities. The print from Microsoft environmental reporting shows the Location-based and Market-based difference but on an aggregated (world-wide) level and only Market based is taken further in the disclosures and dashboards/APIs.



Market-Based Reporting

This method reflects the emissions associated with the **electricity a company has contractually purchased**.

- It includes green energy purchases like Renewable Energy Certificates (RECs) or Power Purchase Agreements (PPAs).
- It allows companies to report lower, even zero, emissions if they've bought enough renewable energy instruments.

Market-based reporting shows what a company has paid for, not necessarily what is truly powering their operations in real time.

Table 2 – GHG emissions by type

	FY20	FY21	FY22	FY23	FY24
Scope 1 (mt)					
Scope 1 – CO ₂	96,700	94,292	99,123	92,466	82,872
Scope 1 – CH ₄	2	3	2	3	2
Scope 1 – N ₂ O	1	1	1	1	1
Scope 1 – HFCs	19	27	37	49	58
Scope 1 – SF ₆	0	0	0	0	0
Scope 2 (location-based) (mt)					
Scope 2 – CO ₂	4,305,119	4,984,442	6,349,431	8,034,943	9,904,643
Scope 2 – CH ₄	283	330	382	515	599
Scope 2 – N ₂ O	56	60	75	99	120
Scope 2 (market-based) (mt)					
Scope 2 – CO ₂	454,034	427,606	286,992	390,884	258,217
Scope 2 – CH ₄	19	18	10	23	6
Scope 2 – N ₂ O	5	5	3	6	2

Source/More information: [Location vs Market-Based Carbon Reporting: What You Need to Know, FT: Big Tech's bid to rewrite the rules on net zero, 2025 Microsoft Environmental Data Fact Sheet](#)

Typically, Location based carbon figures are much higher than Market based figures. Important: sometimes Market based figures are provided 'per location', yet this is not the same as location-based figures!

ABN AMRO

We approach suppliers to provide us with the location-based data, and/or kWh, used for ABN AMRO services at specific sites/countries with the corresponding carbon intensities. It is an ongoing process, and it is important that organizations collectively ask for this data. European sustainability legislation like the CSRD also require location-based carbon data. Finally, and importantly our IT Targets (see next chapter) are set and measured against this location-based reality.

NCDD: shared consensus when it is transparent to use market-based figures, and when to use location-based figures would prevent inconsistent, non-comparable reporting across organizations

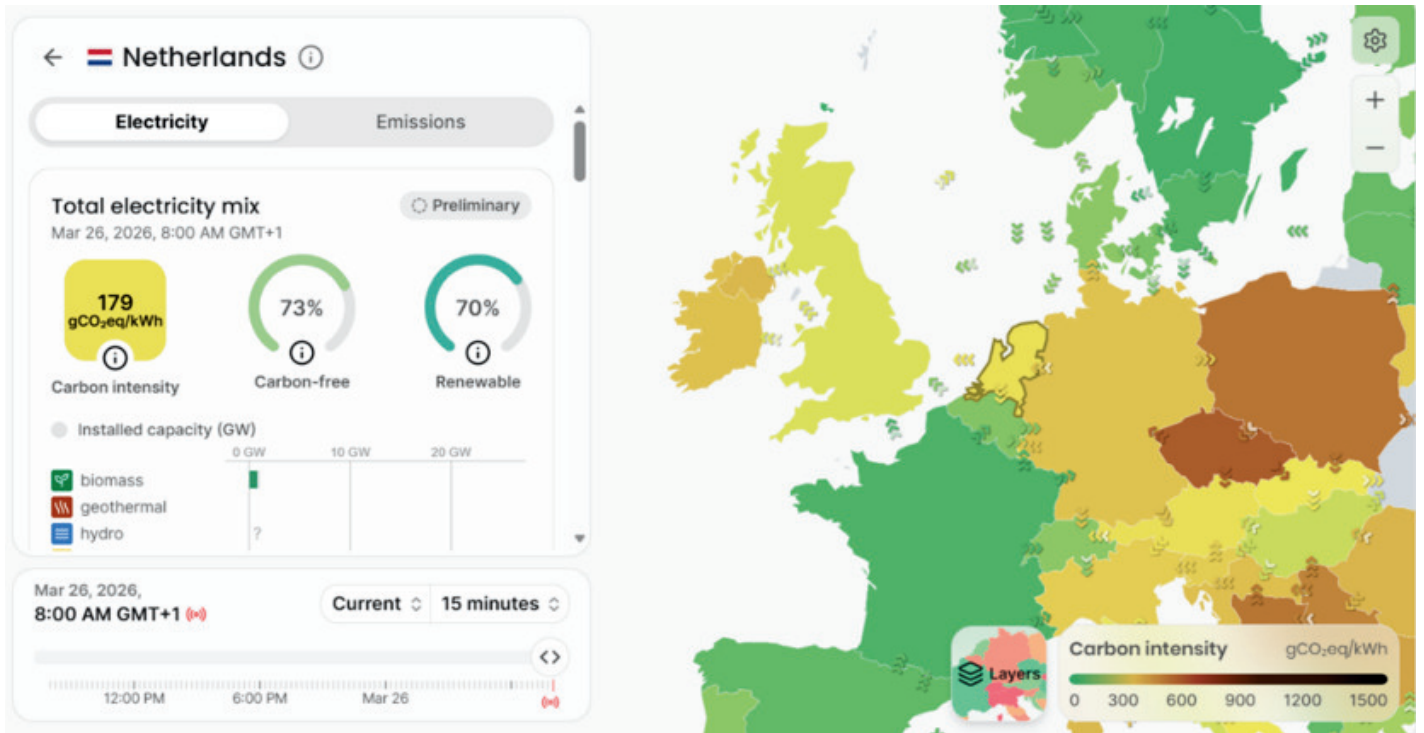
We recommend reporting both: location-based reflects the grid mix of a country (useful for allocating workloads to regions), while market-based reflects investments in/purchasing of renewable energy via PPAs or certificates (GvO's).

Carbon intensity – localized Grid mix data & insights

To calculate with the Location based reality, factual data is needed of the grid mix of your location, preferably as local as possible.

Companies like Electricity maps and WattTime show the electricity mix at any given moment in time (as well as period averages) translating in a carbon intensity of the grid. An API is often available for data feeds into your dashboarding/calculations.

When more renewables (wind/sun/hydropower) are in the mix the carbon intensity reduces (improves), if more fossil fuels (coal/oil/gas) are generating the Electricity supply the intensity increases (deteriorates).



Source/More information: [Netherlands | Electricity Maps](#), [Home - WattTime](#), [Home - wattnet.eu](#)

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The carbon intensity of the grid differs significantly between times of day and between countries, or regions providing a valuable input for our Sustainable IT dashboard in creating (near) real-time and localized Carbon insights.

The insight leads to operational steering information for where and when you run your applications and processes to minimize carbon emissions (Carbon aware operations).

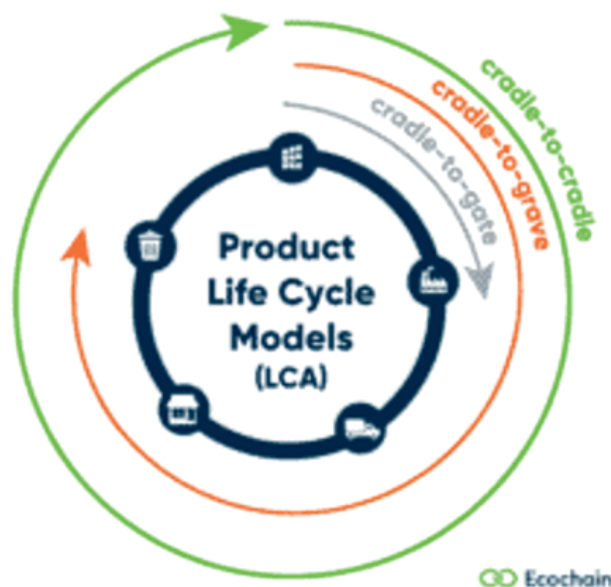
LCA- Life Cycle Assessment (Scope 3)

Another aspect of the IT Carbon footprint is embodied carbon: the carbon that was emitted when producing, assembling and transporting an IT Component/asset.

For understanding the environmental impact of a product or service we use a Life Cycle Analysis via the ISO14044 standard. Specialized companies can perform an LCA on products, repositories of LCA 's exist at companies like [Ecoinvent](#).

Academic or research organizations sometimes also perform LCAs to study the content, like this one [LCA of a Nvidia A100 GPU](#). Not every product (IT asset) has had a LCA performed, if no product specific LCA exists often the nearest 'comparable' LCA is used as a 'Proxy'.

In the near future EU Demanded [Digital product passports](#) are expected to provide information about specific products.



<https://ecochain.com/>

When looking for specific IT asset LCAs service providers like Resilio and Rejooose can play a role.

Source/More information: [Life Cycle Assessment \(LCA\) – Everything you need to know | Ecochain](#), [ecoinvent - Data with purpose](#), [ISO 14044: Life Cycle Assessment - Requirements and Guidelines - ISO Library](#), [L.1410 : Methodology for environmental life cycle assessments of information and communication technology goods, networks and services](#), [LCA of AI: L.1801 Explained — AI's Environmental Rulebook](#), [LCA of a Nvidia A100 GPU](#).

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We annually applied the LCA method (with Ecochain) during the first years (2020-2022) to obtain a fast and high-over indication of our IT footprint. It is especially

useful to show materiality within the total own operations emissions. This method was superseded by the Sustainable IT dashboard, which captures our footprint more frequent and more granular.

Spend based method (EEIO)

The spend-based method, officially based on **Environmentally Extended Input-Output (EEIO)** models, translates financial spend into an estimated carbon footprint by applying an emission factor to the amount spent.

EEIO models combine economic data, describing transactions between sectors, with environmental data such as greenhouse gas emissions. This results in average emission factors per monetary unit for different sectors or product categories. In its simplest form the calculation is:

$$\text{Spend} \times \text{emission factor} = \text{estimated emissions}$$

The method is especially useful when no supplier-specific or physical activity data is available. Financial and procurement data is often already available within an organization, making EEIO a relatively fast way to create a first estimate of the footprint. It can therefore be useful for a first baseline, high-level Scope 3 reporting or to identify the categories and suppliers where emissions may be material and where better data should be obtained.

A caveat of the spend-based method is that it remains an indirect or **proxy approach**. The emission factors are typically based on sector averages and may be a few years old. They therefore do not necessarily reflect the latest or actual situation of a specific supplier, technology or location.

Another limitation is the direct relation between the calculated footprint and the amount of money spent. When spend increases because of inflation, contract negotiations or price increases, the calculated footprint will increase as well, although nothing may have changed in the underlying solution, energy use or actual carbon emissions. The same applies in the opposite direction when prices decrease.

Spend is also not always a good indicator of carbon intensity. An expensive service may have a relatively small physical footprint, while a lower-cost product or material can be carbon intensive. This limits the use of spend-based calculations when the objective is to steer on **actual emission reductions**.

Spend-based accounting is therefore useful as a **high-level method for screening, baseline setting and identifying hotspots**, but less suitable for measuring the effect of specific reduction measures. Where possible, the intention should be to move over time from spend-based estimates towards more specific physical activity data and ultimately supplier-specific data.

Typically, EEIO is a valid route when:

- no supplier-specific or activity data is available.
- a first estimate is needed relatively quickly.
- a large number of suppliers or purchasing categories need to be covered.
- the objective is to identify emission hotspots.
- or a baseline is needed before more detailed measurement becomes possible.

A practical maturity path is therefore: **Spend based → Activity based → Supplier specific.**

Moving from left to right generally improves the relation between the reported footprint and the actual underlying emissions, and therefore also improves the ability to steer on reductions.

Factors / coefficients are available via for example:

- **NL:** [Home | CO₂-emissiefactoren](#)
- **EXIOBASE:** [Exiobase](#)
- **NACE:** [NACE-code, Air emissions accounts by NACE Rev. 2 activity](#)
- **EPA:** [US Environmentally Extended Input-Output \(USEEIO\) Models](#)

Source/More information [Spend based emission factors, Guidance on the use of EEIO models for spend-based carbon accounting – Watershed](#)

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We so far applied Exiobase factors when using the spend-based method and now re-align with our Group Sustainability.

EXIOBASE is an environmentally extended multi-regional input-output database (roughly 200 product and 163 industry categories) that provides cradle-to-gate emission factors per euro of spend, per product category and per region.

Its industry classification broadly follows NACE/ISIC and its product list the EU CPA.

‘NACE factors’ attach an emission intensity directly to the NACE activity code of a supplier or spend category, usually derived from the Eurostat air emissions accounts. NACE is the taxonomy the rest of a financial institution already uses for counterparty classification and financed emissions.

The trade-off is granularity versus consistency: EXIOBASE gives more product- and region-specific detail, which helps to find IT hotspots, while NACE-based factors keep the IT figures aligned with how the organization classifies spend and reports elsewhere (CSRD, financed emissions), which matters for assurance.

Both factors remain sector averages expressed in basic prices: they are refreshed only every few years, need an inflation correction when applied to recent spend, and will show a higher footprint simply because you spent more. In general, it is important to be clear about which coefficient(s) you use and to preferably harmonize this across your organization.

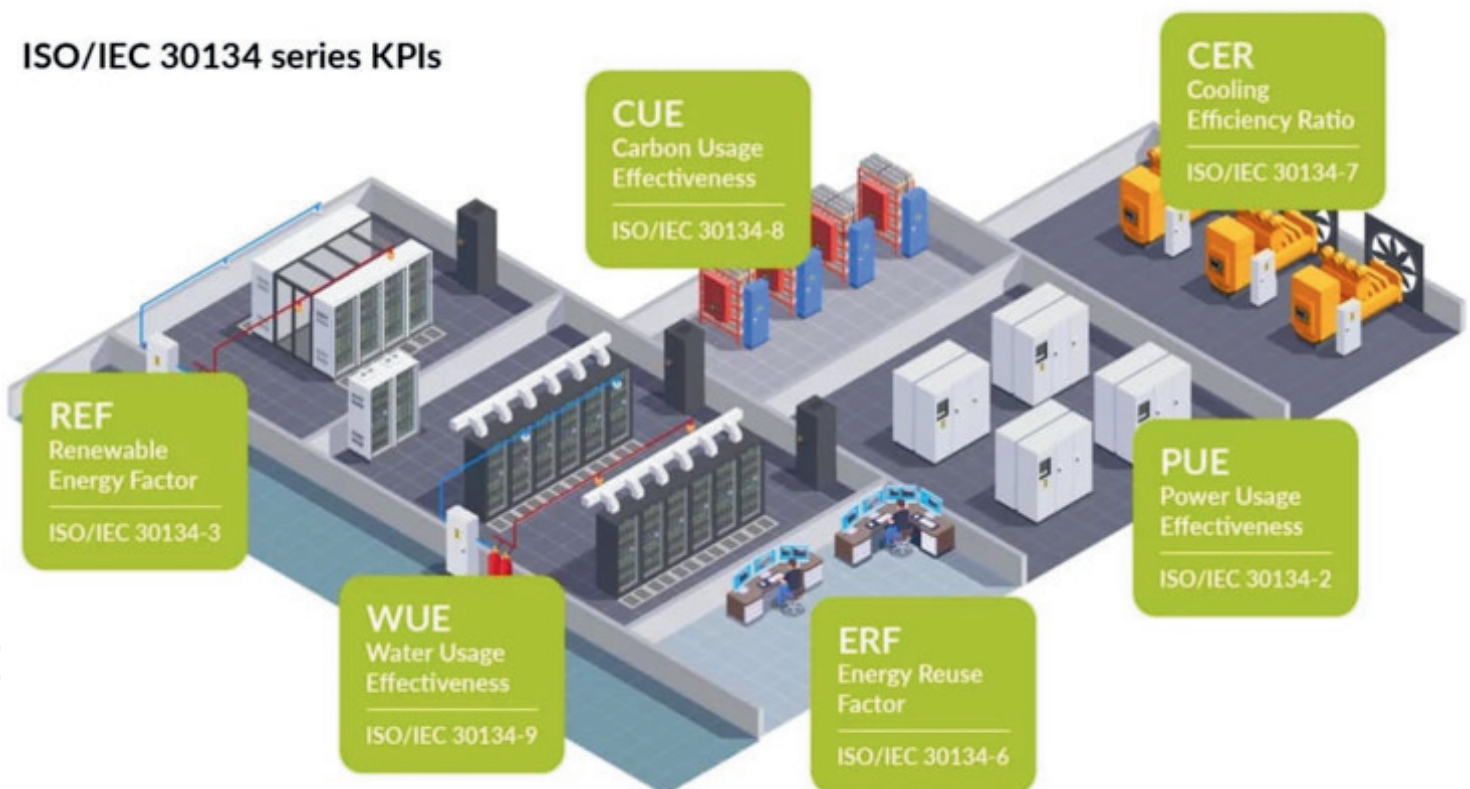
Overview of (upcoming) standards for calculating emissions

On top of the calculation methods above ideally there would be a form of standardization specific for IT, no de-facto Sustainable IT (or AI) standard exists, yet multiple proposals and initiatives appear(ed), a limited list below.

Existing, emerging or proposed IT (AI) standards.

- [ISO/IEC JTC 1/SC 39 - Sustainability, IT and data centres](#)
 - ISO/IEC 30134-1:2016 - Information technology — Data centres
 - ISO 14040, 14044 and 14067, 20125
 - Digital services eco-design (ISO/IEC 20125-1:26)
- [Environmental Sustainability Standards | SustainableIT.org](#)
- [Technology Carbon Standard](#)
- <https://www.sustainableaicoalition.org/roadmap-of-standardization>

ISO/IEC 30134 series KPIs



Source : [ISO/IEC 30134-2 Compliance for Data Centers](#) | [Aravolta](#) | [Aravolta](#)

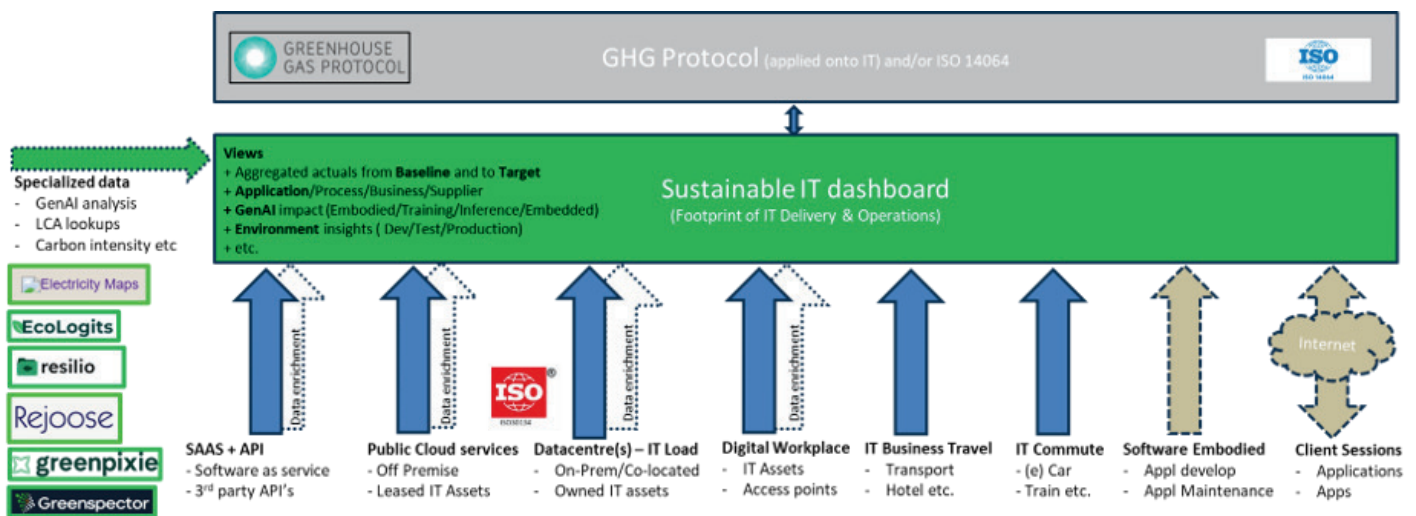
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We have not applied one specific standard, but the ISO/IEC JTC 1/SC 39 workgroup on Sustainability, IT and data centres seems well positioned to play this standardization role, we will track the developments.

NCDD: because no de-facto Sustainable-IT standard exists yet, helping to share models, best practices and learnings is a natural role for the NCDD.

Multiple IT categories can be identified, measured and aggregated into an overarching 'Dashboard', when grouped together via the GHG protocol this leads to operational insights, management information and/or input for reporting.

This dashboard is the lower subpart of the reference model shown earlier (see Overarching (Reference) Model on pg 14 vv) it aggregates and links the measurements of different IT categories. The underlying IT categories will be elaborated in this chapter.



For measuring the overall IT footprint all categories need to be acknowledged, measured and aggregated. Doing this will avoid blind spots and/or focussing on a non-material category while steering.

Typical use cases for the metrics and insights gathered via the dashboard are.

- Operational steering > low-level insight for teams and product owners
- Target setting/tracking > providing (IT) mgt. performance insights (MI)
- Reporting > contributing to reporting obligations/objectives.

The relevant categories are further explained below and typical approaches for measuring are provided.

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Within ABN AMRO we started designing and building our own dashboard in 2020, since we did not find a suitable market offering at that time. By now service providers (like [Conclusion](#)) or actual IT dashboard providers like [Sophit](#) can help you speed up.

SAAS + API

SAAS stands for 'Software as a Service' and probably the most well-known example of SAAS is Office365 by Microsoft. It provides functionality without having to organize the IT 'stack' that enables this service.

SAAS by default is a service and therefore Scope 3 (category 1, purchased goods and services) in the GHG protocol, obtaining impact data like carbon emissions often still proves a challenge. Ideally SAAS providers report the footprint of their services either upfront at contract negotiations or later on during contract management, typically also tools like Helios could be used to drive that demand and collect that data.

Measuring options:

1. The Spend based (or officially EEIO) method.
2. The SAAS supplier exposes an API that provides environmental impact data, an example of MS Office365 can be found here:
 - a. [Calculating My Carbon Footprint | Microsoft Sustainability](#)
3. The supplier shares regular/annual environmental impact data via reporting.
 - a. Capturing this data can be supported by (contract mgt./ESG) tools.

Note: Again verify if the carbon data provided is Market based of Location based

3rd Party APIs (incl. GenAI)

A different way to receive functionality or data is via an API (Application Programming Interface), also behind that capability a footprint will emerge and should be given and measured.

GenAI

The APIs leading to LLMs inference (GenAI) may incur significant impact, yet the footprint details of these models are mostly still limited disclosed by the AI Sector. Data service providers or opensource tools like Ecologits or Greenpixie typically place a (educated) value also on this category.

When GenAI is embedded into the (Saas) Software (like with Co-pilot or Office 365) we today lack the clear specific metrics, this is an important improvement point going forward and a pressing dialogue with the AI supplier(s).

More information and/or other approaches to (start to) calculate the AI footprint can be found here.

1. Ecologits
2. [ITU-T L1801](#)
3. [SustainableIT.org](#)
4. Code carbon
5. Spruce
6. Antarctica
7. [Greenpixie](#)
8. Greenly
9. Tailpipe.ai
10. Neuralwatt
11. GreenPT

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To establishing a footprint of (part of) our GenAI usage we use the Ecologits approach, providing a footprint analysis per token. GenAI use cases are now shown in our dashboard either separately (GenAI view) and/or attributed to the related workload/application. We found Ecologits the most complete and easiest (open source) tool to use at this stage but measuring the AI footprint is a 'hot' and developing topic. We may change approach when needed.

NCDD: AI footprints are not always disclosed yet by the sector (or not in a uniform way); the 2026 NCDD workgroup on GenAI is the place to push for additional and comparable AI data. The workgroup is starting to capture the GenAI ecosystem and impact this IT footprint measuring document does not cover this AI topic in full yet.

Public Cloud Services

Public Cloud services today typically are delivered by US based 'Big tech', but European Cloud players are ramping up fast for Sovereignty and economic purposes hence some are mentioned here also.

Cloud suppliers expose impact data via dashboards and/or APIs. Impact metrics are related to your (x)AAS resource consumption within their platform.

1. Microsoft data: [Calculating My Carbon Footprint | Microsoft Sustainability](#)
2. Google data: [Carbon Footprint | Google Cloud](#)
3. AWS data: [AWS Sustainability Console](#)
4. Scaleway data: [Scaleway Blog](#)
5. OVH data: [Environmental Impact Tracker & carbon footprint | OVHcloud Worldwide](#)
6. Stackit data: [Sustainability in cloud computing | STACKIT](#)

Not all clouds are equally transparent about the environmental impacts of using their platforms.

When metrics are missing, a workaround is needed, and several service providers have filled that void. These additional providers offer data services to enrich or complete the data, such as:

- a. [Cloud carbon footprint software](#) (opensource, now outdated)
- b. [Greenpixie](#) – Azure/AWS and GCP metrics, GenAI footprints
- c. [Ecologits](#) or [CodeCarbon](#)– GenAI Footprints
- d. [Resilio](#)– Embodied Footprints

Also, FINOPS providers have extended their services with carbon transparency an example below.

- e. IBM: [Quantify the Environmental Impact of Cloud Consumption - Apptio](#)

Note: More research into the state of transparency of especially the US cloud providers can be found in this [greenweb foundation](#) research, partly also shown in the appendix.

NCDD: Limited IT footprint transparency of the cloud providers is a hurdle in calculating scope 3 emissions. Aggregating demand from various large user organisations (among the NCDD) can help push the dialogue towards more (granular) disclosures of the energy and carbon footprints of cloud services, including the granular location-based data that is often missing today and is a systemic gap in itself.

Datacentres

Organizations typically may also have their own infrastructure either in their own datacentre or in a co-location facility. This category captures these impact figures, so the energy use/emissions, embodied emissions and other impact factors that come from purchasing, hosting and operating your own infrastructure to run your applications.

Own datacentre and infrastructure emissions are largely Scope 2 (electricity) but also Scope 3 (Supply Chain) for the embodied emissions in the IT hardware.

Measuring options:

1. Datacentre level, if you own the datacentre and infrastructure and workloads running within are yours, the total Energy used for IT is visible in your power distribution (like from [Schnieder Electric](#)) and your energy bills. Related emissions can be calculated market and location based.
2. Demarcations can exist and need to be attributed to IT or to Facility (building) Mgt. (FM) on an organization level they will come together in the total operational footprint but for the IT footprint a demarcation is needed.
 - a. IT load: actual IT infrastructure electricity uses and attributed to IT.
 - b. Facility equipment: Cooling and power distribution and part of FM
 - c. Emergency power supply: Diesel/Hydrogen etc. typically part of FM.

Note: The ratio between IT load and the other factors will indicate the [PUE](#)

3. Tenant level, if you run your infrastructure in a collocated datacentre, you should obtain energy/impact metrics from your 'Colo' provider. Be clear you understand the data, what is included and what is the calculation method?

a. Example: Equinix Sustainability - [Equinix Sustainability](#), they typically can go to your/tenant level to provide impact data/metrics.

4. Within the IT load, further allocations are possible towards specific workloads. Every organisation has to find the appropriate way to do this in the most correct and feasible way possible, whereby also distributing overhead/idling times.

The infrastructure choices/setups/solutioning will differ per organization, IT Assets usually are kept in the CMDB and DCIM administration, which is a typical first datapoint. Secondly the IT consumption (compute/storage/network) needs to be allocated to a logical entity. Typically an application is such a logical entity

- a. A way is to use hypervisor information for the compute allocation.
- b. Allocating storage to the related application via (cost) data insights.
- c. Allocating network traffic to the related application

Another approach is to leverage data out of the control/mgt. planes of the supplier. Often, they also track energy consumption of their assets/infrastructure, it would still have to be assigned accordingly to an application.

5. Some specific solutions may become available to attribute energy within the datacentre, examples.

a. TNO develops [Chantico](#) at the MISD project.

Finally, when a fine-grained cost allocation model exists, it may (only as a rough guidance) serve as a (preliminary) proxy to also allocate and distribute energy/carbon via that key, but it would not accurately reflect the actual situation, so unsuitable to really steer on environmental impact reductions.

ITAD suppliers – Carbon reductions

Part of this Supply chain (downstream scope 3) is IT Asset Disposition (ITAD), decommissioning old devices ideally giving them a refurbishment or recover materials.

When devices (IT assets) are refurbished and get a second life/use this extends their lifetime and distributes the embodied carbon across a longer period of time. Therefore, lowering the carbon attributed to your organization. These carbon 'savings' can be found in the reports of ITAD suppliers that are sent back to your organization and can possibly be deducted within this category.

ITAD Examples: [Why Circular IT?](#) | [Circular IT group](#), [Circu-IT](#) | [ICT oplossingen](#) | [Reuzado](#)

Note: see the product owner's reflection in the appendix for how on-premise energy, embodied emissions and ITAD were handled in practice.

Digital workplace

Office equipment (like laptops, screens and Wi-Fi access points) also have a significant footprint, where most actually sits in the making e.g. supply of those devices, meaning when you receive and open the packaging, nearly 80% of the impact has already occurred!

Measuring options:

1. Supplier e.g. primary data or product carbon footprint (PCF) documentation
 - a. Will show the Embodied carbon footprint, based on the supplier insights into the making of the product, input for Scope 3.
 - b. Will mostly also contain the TEC (Typical Energy Consumption) value, an expected energy use based on averages usage of the device, hence input for Scope 2.
 - c. Underlying the PCF there can still be assumptions and proxy data.
 - d. Supply chains are often complex and extensive making it a challenge to obtain all data and establish the aggregated footprint.
 - e. Not always clear if these product carbon footprints are calculated on a Market or Location (carbon intensity) basis and/or if offsetting has played a role somewhere in the extensive supply chain.
 - f. Suppliers often use different approaches to determine the footprint making it difficult to compare.

An example of PCF information by OEM can be found here: [Koolstofvoetafdruk van product | Dell Nederland](#)

2. 'Proxy data, harmonized/uniform (market) datasets that typically place a footprint value on a device. The proxy approach sometimes depends on the processor package size or die size (the "die" is the small silicon piece at the center of a processor that contains the compute cores). Or specific characteristics of the design. Often LCAs (life cycle analysis) are behind this proxy method.
 - a. Example: Resilio/Rejoose
3. To separately measure or more real-time gather the Electricity used in operation you can capture data from the devices while in use, either via OEM provided (device mgt.) software (if available) or via middleware on the device like with [Nextthink](#).
4. Digital product passports (DPP) are asked by the EU and planned for the future, Roll-out follows the EU workplan; IT monitors will be the first IT category with a DPP requirement. Preparations are ongoing, still too early to use today.

Note: See the appendix for our Product owners' journey and practical challenges with reading device electricity use and finding product carbon footprints.

IT Business travel

When we take the operating model of IT into perspective, we should also integrate the travel footprint of IT employees, especially when the operating model is extensive and takes place in different geographically dispersed locations. Traveling to summits/conferences/training etc. is also an important impact aspect.

Measuring options:

1. Business travel applications: Transport modes Air travel, train, car etc as well as hotel visits have an environmental footprint, which is often captured in the business travel application (like [Egencia](#))
2. Typically, a proxy method (like CBS data) combined with individual employee declarations may yield result for impact data.

IT Commute

On a daily basis IT employees travel to work and back home, changing the frequency and working from home has an effect on the footprint of that commute cycle. Within the [Netherlands a legal obligation](#) exists for larger companies to measure and report this impact.

1. Determine and measure on an individual basis, by letting personnel hand in detail about how/when they commuted to work.
2. Aggregating the totals to have a corporate view.
3. Measure on a collective basis by using market/CBS data to determine a typical commute mode distribution and corresponding impact.

Capturing this data often sits with HR, for our dashboard an IT subset of that data has been identified and fed into the Sustainable IT dashboard.

Software embodied carbon (additional)

This category captures that footprint of Application development and maintenance (ADM) of Commercial off-the-shelf (COTS) software, Opensource software, Blockchains or proprietary Software not developed on your own infrastructures but at a (ADM) suppliers' facility.

Once installed and running this software footprint is expressed via our own infrastructure footprint either in your datacentre, public cloud or end user devices (digital workplace or customer side). In the previous stage software has had a 'supply chain' and was created, updated and distributed. This incurred an embodied footprint.

Attributing a part of these emissions to the (e.g. ABN AMRO) account that the work was done for in line with GHG scope 3 of upstream supply chain 'Services'.

Measuring options:

1. Account reporting by Software (ADM) suppliers.
2. Spend-based accounting (approximation) by the Operating company.

We have acknowledged this category and start to gather the data from our (ADM) partners, but the data is not yet integrated into our Dashboard, this is a roadmap item.

Client Sessions (additional)

This category captures that energy use and emissions downstream of the operating company from/by customers running your software typically an app/application/API over an internet connection.

Measuring options:

1. Based on research like: [Greening of streaming](#)
2. [Greenspector Studio | App efficiency and performance on real devices](#)

We have acknowledged this category but not yet integrated it into our Dashboard, this is a roadmap item.

Dashboard Views

We have created multiple views in our Dashboard. Often assisted by 'equivalents' like charging so many phones or electrical cars, see the appendix section for dashboard view screenshots.

Overall view

Containing mgt. information on IT footprints totals and trends.

Target and Baseline view

Containing the fit/gap with our targets (into the future) and/or baseline (reflecting on the past)

Application view

Grouping impacts on an application level for 'DEVOPS' teams and Application owners.

GenAI View

Absolute metrics:

- GenAI footprint totals and trends
- GenAI attributing to applications (and/or business processes).
- Net. Effect view, consolidating Carbon gains and impacts from GenAI. roadmap item

Intensity metrics:

- Energy/token and Carbon/token, roadmap item.

Business (process and intensity) view

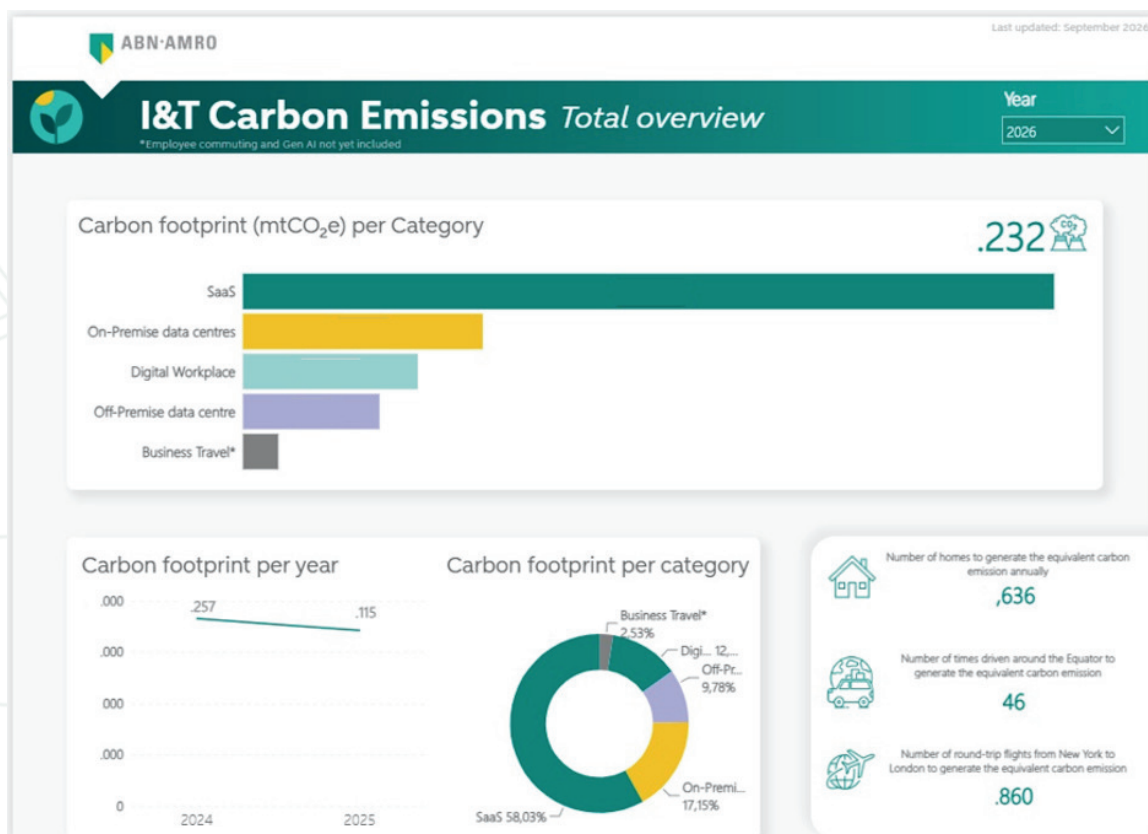
Aligning with e2e business processes and allocating footprint to those processes and typical transactions (like carbon per Mortgage handling or Internet banking transaction). This is still work in progress and a roadmap item.

Supplier view

Accumulating a footprint view per supplier, its totals and per product/service. This is still work in progress and a roadmap item.

Emissions can be shown in a Market-based and Location-based calculations via a toggle switch.

An example of a dashboard views is shown below; the full set is included in the appendix.



Note: Values are illustrative for this paper only and do not provide ABN AMRO actuals.

More visuals of Sustainable IT dashboard views can be found in the appendix.

Measuring is the main objective of this white paper but the challenge continues. Earlier we identified the different categories of the IT footprint, discussed how these can be measured and how the results can be brought together in the Sustainable IT dashboard. The next step is to use these insights to steer on reducing the footprint.

This part is therefore about steering: setting targets, establishing baselines, translating targets into KPIs and OKRs (Objectives and Key Results) and running a continuous management cycle. Management systems such as ISO 14001 and ISO 50001 can help to embed this cycle in the organization, while maturity models can be used to understand how far an organization has progressed. Finally, the ABN AMRO Sustainable IT approach and the S-rating show how this steering can be translated into day-to-day IT management and design decisions.

Setting Targets

Organizations often set targets on carbon reductions or moving to 'Net Zero'. To make such targets meaningful, it is necessary to understand a few defining aspects:

1. What is taken into (GHG) scope?

- Which IT categories and how far down the supply chain?

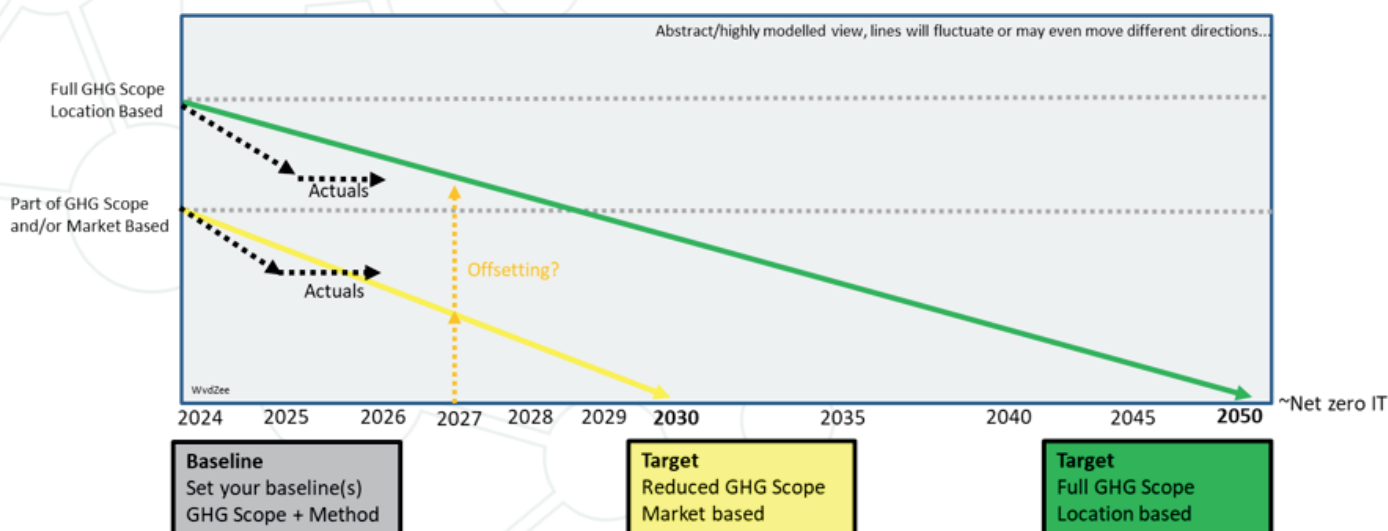
2. What calculation method are these targets based on?

- Location based, Market based or both.

3. Does offsetting play a role in your targets?

- What is the quality of that offsetting?

These choices are important because a reduction target only becomes meaningful when it is clear what is being reduced and how it is measured. A target covering just part of the IT scope cannot directly be compared with a target covering the full IT footprint, and a Market based result cannot simply be compared with a Location based result.



The figure illustrates this principle. A baseline is established first, using a defined GHG scope and calculation method. From there different target trajectories can be defined. A target may initially cover part of the GHG scope and/or use Market based accounting, while the longer-term ambition can extend towards the full GHG scope and Location based emissions. The green trajectory illustrates the longer-term ambition towards Net Zero IT, while the shorter trajectory represents an intermediate target with a limited scope.

The actual measured footprint can (and probably will) fluctuate around these trajectories. Actuals may also change when new datasets are introduced or existing data is modified, typically due to changing calculation methods, emission factors or new data points. It is therefore important that changes in the measurement itself can be distinguished from actual changes in energy use and carbon emissions.

Baselines

Aside from setting targets into the future, you can also look back onto an earlier defined **baseline**.

Once you have defined your categories, obtained the necessary data and aggregated these into a Sustainable IT dashboard, you can define a moment in time to act as a baseline. Tracking progress against that baseline is valuable to understand incremental results and longer-term trends.

The baseline and the target are therefore closely related: **the baseline determines where you start, while the target determines where you want to go**. Ideally both are based on the same scope and calculation method. Where methods, emission factors or data sources change materially, the effect on the baseline should be understood to maintain a meaningful comparison over time.

SBTi – Science Based Targets initiative.

Once an organization has defined its own baseline and reduction targets, the next question is how these ambitions relate to the reductions required from a climate perspective. IT targets typically form part of company-wide targets and, when IT is material, should be included in that wider ambition.

The **Science Based Targets initiative (SBTi)** provides an external framework against which organizations can have their climate targets assessed.

“The Science Based Targets initiative is an institution where companies have their climate plans assessed. SBTi determines whether they comply with the Paris Agreement. In that agreement, countries committed to trying to limit global warming to below 2 degrees Celsius, preferably 1.5 degrees — the threshold science considers safe. An organization that wants to demonstrate it takes climate change seriously has its plans evaluated by the organisation.”

For investors and other stakeholders such external assessment can provide an additional reference for the credibility of climate targets. At the same time, discussions continue around the further development and direction of the SBTi.

More information: [Ambitious corporate climate action - Science Based Targets Initiative](#), [Klimaatkeurmeester SBTi verscheurd door richtingenstrijd](#)

Intensity versus Absolute targets

A target can be expressed as an absolute reduction or as an intensity reduction.

While your intensity — carbon per unit — may move in the right direction and improve, your total or absolute emissions may still grow as a result of producing or consuming more ‘units’. This can be related to the rebound effect, sometimes referred to as the [Jevons Paradox](#).

For example, the carbon footprint per transaction may decrease while the number of transactions increases faster. In that case the IT solution has become more carbon efficient, but the total footprint can still increase!

Setting targets on intensities can therefore be useful, but typically secondary to absolute targets.

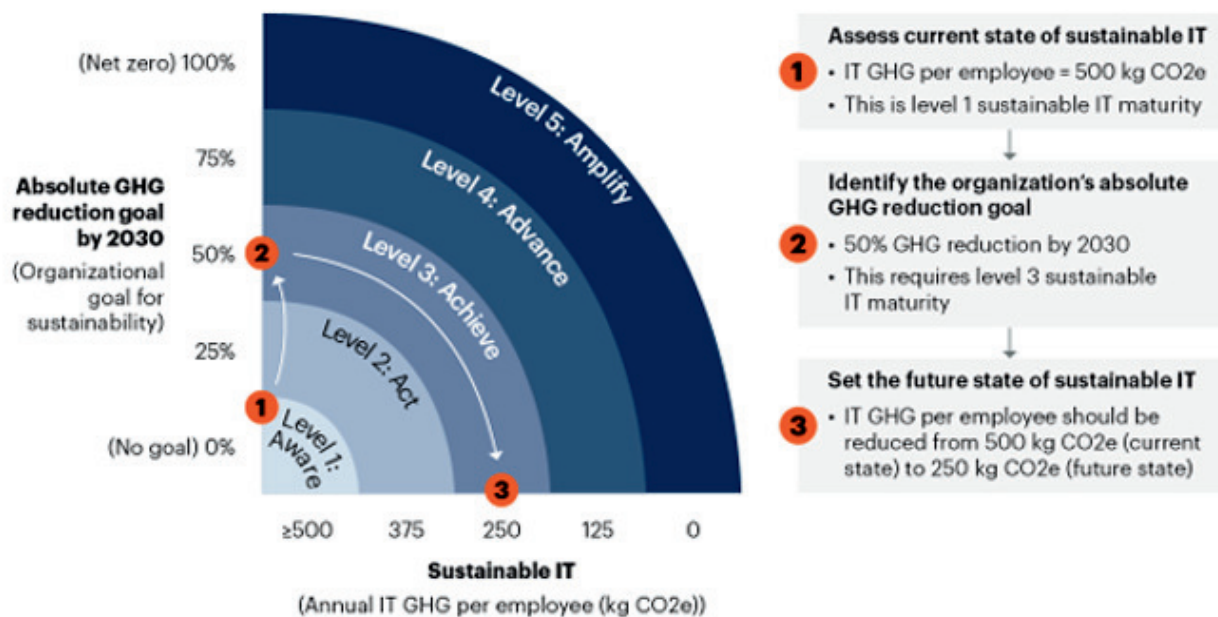
An example of an intensity metric for software is the [Software Carbon Intensity \(SCI\) Specification](#).

Typical intensity comparisons can be:

- [Carbon / Employee](#)
- [Carbon / Revenue or Profit](#)
- [Carbon / Client or Transaction](#)
- [Carbon / Application or GB, etc.](#)

The Gartner example brings the two perspectives together. It illustrates that the development of the absolute footprint and the development of carbon intensity should be looked at together. An organization can improve its relative efficiency while still moving away from an absolute reduction target, or it can improve on both dimensions.

Example for How to Evaluate Sustainable IT Maturity



Gartner

This also explains why intensity metrics can be useful for operational steering and comparison, while absolute emissions remain necessary to understand the total environmental impact.

A pre-condition to compare or even benchmark organizations is to first correctly harmonize on methodology and (GHG/IT/Functional) scopes. Comparing two carbon-per-employee or carbon-per-transaction figures has limited value when the underlying IT categories, boundaries or calculation methods are very different.

When to Use Which?

- **Use Absolute Emissions:** To align with science-based targets, set Net Zero goals or report total environmental impact.
- **Use Carbon Intensity:** To measure operational efficiency improvements, provide additional benchmarking or understand the footprint in relation to changing business volumes.

Absolute and intensity metrics therefore serve different purposes and can complement each other.

NCDD: comparing organizations only works once methodology and GHG/IT scopes are harmonized – a core task for the NCDD. This is a relevant area for the NCDD to contribute, based on user experiences.

Typical KPIs and OKRs

Once targets have been defined, they need to become part of the management cycle. KPIs and OKRs are ways to translate the longer-term reduction trajectory into goals that can be followed on a frequent basis through the Sustainable IT dashboard and management reporting.

For ABN AMRO we have defined OKR and KPIs over the past years. Sometimes they do not cover the full scope but on specific categories where we believe we can achieve the most progress and/or where we have the best data available.

2025 OKR: -4% Carbon

Location based, based on 4 out of 6 categories of the IT footprint: Off-prem DC (Public Cloud), On-prem DC, Digital Workplace and Business Travel

2026 KPI: -4% Carbon

Location based, based on 4 out of 6 categories of the IT footprint: Off-prem DC (Public Cloud), On-prem DC, Digital Workplace and Business Travel.

An OKR typically raises more senior management attention than a KPI. Since we more than achieved the 2025 OKR we returned to a KPI setting for 2026. The -4% relates to the longer-term 2050 Net Zero ambition shown earlier.

The dashboard, baseline, targets and KPIs therefore form one chain:

measurement provides the actuals, the baseline provides the reference, the target provides the direction and the KPI or OKR makes progress part of the management cycle!

Certifications

When you continuously measure your footprint, have set targets and put in place a management system to actively steer on that footprint, you can also become eligible for certifications.

Certification is therefore not the reduction measure itself. It can help to **formalize and embed the management system** around measurements, targets, responsibilities, monitoring and continuous improvement.

ABN AMRO is **ISO 14001 (environmental management)** and **ISO 50001 (energy management)** certified, which also includes IT operations. Obtaining these certifications also contributes towards the compulsory EED audit requirements.

Certificaat

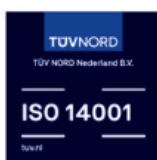
voor het milieumanagementsysteem volgens

NEN-EN-ISO 14001:2015

Inclusief vigerende versie van het onderliggende SCCM schema

De certificatie instelling TÜV NORD Nederland bevestigt hiermee dat de certificatie heeft plaatsgevonden volgens haar certificatiereglement voor de organisatie

ABN AMRO Bank N.V.
Gustav Mahlerlaan 10
1082 PP Amsterdam



Certificaat

voor het energiemanagementsysteem volgens

NEN-EN ISO 50001:2018

Inclusief vigerende versie van het onderliggende SCCM schema

De certificatie instelling TÜV NORD Nederland bevestigt hiermee dat de certificatie heeft plaatsgevonden volgens haar certificatiereglement voor de organisatie

ABN AMRO Bank N.V.
Afdeling Workplace Management
Gustav Mahlerlaan 10
1082 PP Amsterdam



The ISO 14001/5001 The certificates above indicate how the Sustainable IT activities are embedded within the broader ABN AMRO environmental and energy management systems. Where the previous paragraphs focused on the carbon target itself, these standards address the **management process around achieving and continually improving against such objectives.**

The ISO 14001 / 50001

ISO 14001 is the internationally recognized standard for environmental management systems (EMS). It provides a framework for organizations to design and implement an EMS and continually improve their environmental performance. By adhering to this standard, organizations can ensure they are taking proactive measures to minimize their environmental footprint, comply with relevant legal requirements and achieve their environmental objectives. The framework encompasses various aspects, from resource usage and waste management to monitoring environmental performance and involving stakeholders in environmental commitments.

ISO 50001 is based on the management system model of continual improvement also used for other well-known standards such as ISO 9001 or ISO 14001. This makes it easier for organizations to integrate energy management into their overall efforts to improve quality and environmental management.

Other certifications - The Dutch 'CO₂-Prestatieladder'

The CO₂ Performance Ladder is an instrument that encourages CO₂ reduction while rewarding sustainable organizations. Companies that can demonstrate lower emissions can gain an advantage in procurement and tendering processes. The [Ladder](#) therefore serves both as a procurement instrument and as a CO₂ management system.

Obtaining certifications can contribute to integrating and embedding sustainability within the organization.

Other certifications - Product level certifications (or Ecolabels)

For assessing IT assets on product level there are product level certifications or ecolabels to consider, a few main ones are stated below.

- TCO Certified - [The global sustainability certification for IT products](#)
- EPEAT - [EPEAT Registry](#)
- Energy Star - [Homepage](#) | [ENERGY STAR](#)

Within ABN AMRO we adopted the TCO certification for end user devices.

The Sustainable IT Approach of ABN AMRO

A maturity model can tell you **where you are**. An operating approach is needed to organize **what you continuously do to improve**. The approach below is how ABN AMRO organizes this steering in practice.

Measuring and dashboarding is one important aspect, but to steer on and embed sustainability within IT more actions are needed. We steer on Sustainable IT via this continuous approach:

- Research: We develop and gain Subject Matter expertise
- Dashboards: We develop products and services for metrics and insights
- Toolbox: We collect and share tactics via our Toolbox
- People Enablement: We develop and facilitate knowledge sharing services.
- Embedding: We act as a catalyst for integrating Sustainability in IT processes
- Reporting: We contribute to reporting and compliance
- Governance: We coordinate, collaborate and communicate to assure quality and coherence
- Targets: We align, define and follow-up on the goals



The figure shows that this is **not a one-off or linear process, but a continuous cycle**. Strategy and targets provide direction. Research and dashboarding create knowledge and insights. The toolbox and people enablement help translate these insights into interventions. Embedding brings them into processes and deliverables, while reporting and governance provide feedback and accountability. The results can then feed back into strategy and targets for the next cycle.

In this way the earlier elements of this chapter — measurement, targets, KPIs, management systems and maturity — come together in one operating approach.

S-rating & GenAI Sustainability Rating

The approach above describes steering at an organizational level. To influence the footprint, sustainability also needs to become part of individual IT and architecture decisions. The S-rating translates this into a practical non-functional design consideration at application and infrastructure level.

Sustainability Rating – S

Enhancement to workload classification structure: CIA-P-S

Sustainability Rating	Resource Dynamics Archetypes/Characteristics Applicable on Product, Workload and/or Business process level	Typical Backgrounds, Exceptions, conditions
0 Label A	‘Default-off’ Resources scaling back to 0, when no demand present/needed** Resources dynamically (de)allocated when workload in use*	- Continuous Rightsizing (CR) on Prod - Compute scaling down to 0 - Data (I/O, Storage) scaling down to 0 * Functional demand by sessions/transactions/analytics/.. ** Excl. listener/log/orchestrator/backup(s)
1 Label B	‘Default-off’ Resources not scaling back to 0, when no demand present/needed** Resources dynamically (de)allocated when workload in use*	- Non-Continuous Rightsizing (CR) on Prod - Compute scaling down to 0 - Data not scaling down to 0, persistent storage
2 Label C	‘Partly-off’ - minimal 3 of 3: 1. No permanently allocated DTA resources 2. No permanently allocated DR resources 3. No permanent allocated Peak load resources	- Resources reside in shared platform (resource pool) - On demand automated (de)provisioning
3 Label D	‘Partly-off’ - minimal 2 of 3: 1. No permanently allocated DTA resources 2. No permanently allocated DR resources 3. No permanent allocated Peak load resources	- Resources reside in shared platform (resource pool) - On demand automated (de)provisioning
4 Label E	‘Partly-off’ - minimal 1 of 3: 1. No permanently allocated DTA resources 2. No permanently allocated DR resources 3. No permanent allocated Peak load resources	- Resources reside in shared platform (resource pool) - On demand automated (de)provisioning
5 Label F	‘Default-on’ All workload resources permanently allocated and active.	- All Resources are continuously allocated and active. - Incl. DR/Peakload/DTA (Development, Test, Acceptance)

WvdZee Febr. 2020

Source: S-Rating model – Wiebren van der Zee - 2020

The S-rating classifies infrastructure according to the way resources are allocated and used. At the green end of the scale resources are largely **‘default-off’** and become available when demand requires them. Moving through the rating, more resources remain permanently allocated or active. At the red end, **‘default-on’**, resources remain permanently allocated and active, constantly in need of resources/energy also when no (business/developer) demand is present.

The purpose of the rating is to make resource efficiency visible as a design characteristic. Sustainability can then be discussed alongside other non-functional requirements during solution and architecture decisions rather than only being measured afterwards.

We created a dashboard view for assessing ABN AMRO application infrastructures on the dynamics of resource allocation, the view can be found in the appendices.

A separate **GenAI Sustainability Rating** proposal was contributed to and released during the 2026 [TNO AI Challenge](#) and is to be matured and adopted further.

GenAI-Sustainability Rating – Linking into EED/ETS/CBAM/CE							Wiebren van der Zee - April 2026 Version 0.91
Assessing/scoring characteristics of GenAI							
Sustainability Rating	Inference phase		Training phase - Carbon/Model	Embodied - Carbon/Hardware	Circularity - Minerals	Water - Stress	Consequences
	Energy/Token	Carbon/Token					
A	< 0,001 Joule	< 1 Gram	< 1 Ton	< 10 Kg	> 90% Circular	< 0,000001	- No ETS/CBAM Regime - No additional Carbon Taxation - Reward: 5% Carbon Credits
B	< 0,01 Joule	< 10 Gram	< 10 Ton	< 50 Kg	> 75% Circular	< 0,00001	- No ETS/CBAM Regime - No additional Carbon Taxation - Reward: 2% Carbon Credits
C	< 0,1 Joule	< 20 Gram	< 25 Ton	< 100 Kg	> 50% Circular	< 0,0001	- No ETS/CBAM Regime - No additional Carbon Taxation - No reward
D	< 1 Joule	< 30 Gram	< 50 Ton	< 250 Kg	> 25% Circular	< 0,001	- Under ETS/CBAM Regime - Carbon Taxation + 10% - Incentive to move higher up
E	< 2 Joule	< 40 Gram	< 100 Ton	< 500 Kg	> 10% Circular	< 0,01	- Under ETS/CBAM Regime - Carbon Taxation +20% - Incentive to move higher up
F	> 2 Joule Or no Data from supplier	> 40 Gram Or no Data from supplier	> 100 Ton Or no Data from supplier	> 500 Kg Or no Data from supplier	< 10% Circular Or no Data from supplier	> 0,01 Or no Data from supplier	- Under ETS/CBAM Regime - Carbon Taxation + 30% - Incentive to move higher up
Remarks	Energy usage per Token (Joule/Token)	Emissions (GHG) per Token (CO2eq/Token)	Emissions (GHG) per Model Post + Pre Training (CO2eq/Model)	LCA/PCF:Comp./Stor./Netw. GHG: Manufacturing and decom. (CO2eq/IT Assets (avg))	GCP(CTI) based Link with CRMA + Circ. economy Act.	Water use vs availability at infer. Location (mL/Token)	

Source: GenAI Sustainability Rating model – Wiebren van der Zee - 2026

The GenAI Sustainability Rating applies the same principle to Generative AI. Instead of looking only at one metric, the table combines several sustainability characteristics into an **A-to-F rating**. This creates a relatively simple design signal for comparing or assessing GenAI solutions while retaining the underlying sustainability criteria. Finally, the model contains a proposed bonus/malus system tied into EU legislation for rewarding the greener options.

Both frameworks could be used as **non-functional design drivers**, comparable to ratings such as the CIA classification or as part of a broader assessment methodology.

NCDD: shared, non-functional sustainability ratings such as the S-rating could become a sector standard the NCDD promotes.

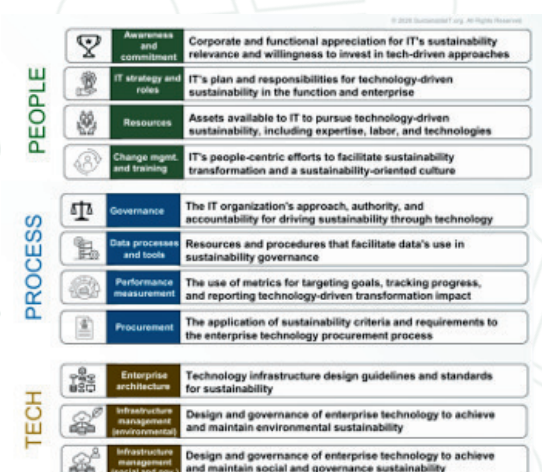
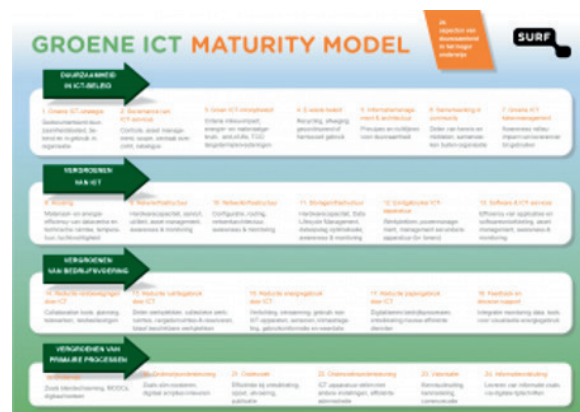
Measuring your maturity - Green IT Maturity Models

Management standards and certifications provide one way to structure continuous improvement. A related question is how mature the measuring (and potentially full Sustainable IT) capability of the organization is.

To understand and assess where you and your organization sit in terms of maturity of adopting Green IT, a number of maturity models exist. No de-facto standard exists, but these models can help to understand where in the journey you are and what should be done and/or achieved next.

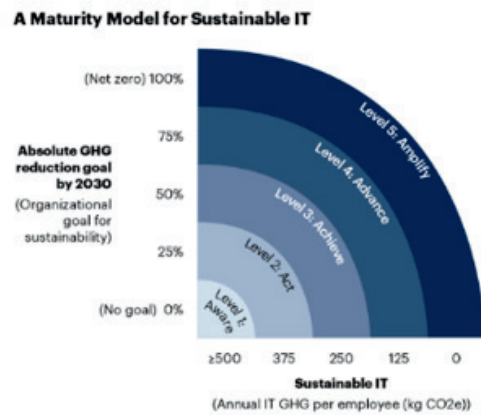
A collection of Green IT maturity models:

1. TUE: [Green IT capability Maturity model](#)
2. Surf: [SURF Green IT Maturity Model | SURF.nl](#)
3. Gartner: Gartner, Inc. | G00813159 (members)
4. GSF: [Green Software Maturity Matrix | Green Software Maturity Matrix](#)
5. [SustainableIT.org/Sundberg: SUSTAINABLEIT.ORG](#) incl. online assessment (members)



	ASPIRING	AWARE	ACTING	AWESOME	INSPIRING
commitments	none	carbon neutral	carbon zero with efforts	10% (offset)	1% (offset)
footprint	unknown	know scope 1&2	reducing per unit	reducing absolutely	-zero
metrics	none	report scope 1&2	daily scope 1&2/3	realtime	predicted
carbon ops	none	manual	lightswitch ops	auto-right-sizing	carbon SRI
energy	none	green hosting	dynamic management	demand shaping	24/7 Carbon Free Electricity
devices	none	some targets	10y/90%	10y/100%	rolling repair
utilization	none	some multi-tenant	all multi-tenant	max orchestration	edge integration
products	none	carbon awareness	demand shaping	feature tracking	future carbon error budgets
training	ad hoc	basic champions	advanced	you are the trainer	you are the leader

Figure 1: A Maturity Model for Sustainable IT



The examples above illustrate that different maturity models use different dimensions, maturity levels and visualizations, but broadly serve the same purpose: **assessing the current state, identifying gaps and defining the next steps towards a more mature Sustainable IT practice.**

NCDD: no de-facto maturity model exists either; helping the sector to converge is a natural NCDD role. Where convergence is possible, the NCDD also has a role in clarifying the differences between models (which model suits what) and in building shared experience with one model for knowledge sharing and further development.

In part 3 we moved from **measurement to steering**: from baselines and targets, through KPIs and management systems, towards organizational maturity and concrete design interventions. This creates the management capability to reduce the IT footprint.

This next part looks at the other side of that capability: how the resulting information is used for **accounting, reporting, compliance and scaling across the organization**. In this chapter we describe how the outcomes have to be accounted for, towards the company strategy and towards legal compliance, voluntary reporting and offsetting.

Reporting for Legal compliance

Organizations often take a compliance driven approach, doing what minimally needs to be done from a legal perspective. Of course, organizations can do more than that, by signing covenants, sector ambitions or setting in-company sustainability goals (often to align also with their purpose).

The reporting requirements of European sustainability laws

Not all organizations are subject to the same regulation, or at least not directly.

CSRD (Corporate Sustainability Reporting Directive) – after the Omnibus adjustment

The essence of the CSRD after the Omnibus proposal is a more targeted, simplified sustainability reporting regime focused on large companies and material information.

CSRD's core objective remains unchanged: companies must disclose reliable, comparable ESG information covering environmental, social, and governance topics, based on double materiality (impact on society and financial risk).

However, the Omnibus proposal introduces key simplifications:

- **Narrowed scope:** Only companies with ~1,000+ employees (and financial thresholds) are in scope, significantly reducing the number of affected companies and excluding most mid-sized firms.
- **Simplified reporting:** The ESRS standards are streamlined, reducing the number of required datapoints and focusing on decision-useful, material disclosures rather than exhaustive reporting.
- **Stronger materiality focus:** Companies have more flexibility to determine what is relevant, reinforcing a shift from compliance-driven “checklists” to meaningful reporting.

- Reduced value chain burden: Requirements to collect detailed data from suppliers are limited, easing pressure on SMEs in the value chain.
- SMEs largely excluded: Listed SMEs are no longer required to apply full CSRD but may use a voluntary simplified standard.
- Delayed timing: Companies not previously under NFRD are expected to start reporting around FY 2027 (reports in 2028).

Key elements remain assurance, EU standards (ESRS), digital tagging, and integration into the management report.

In essence: CSRD becomes a leaner transparency framework for large companies, centered on material ESG information rather than extensive compliance reporting.

Note. The section above was created with the help of GenAI, more information: [Corporate sustainability reporting - Finance - European Commission](#), [Sustainable IT Impact Assessment \(SIIA\) – Nationale Coalitie Duurzame Digitalisering](#)

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The planned revision of the GHG Protocol Scope 3 standard (≥95% coverage) is expected to make IT-related purchased goods and services materially more relevant for reporting. From our (IT) perspective and measurements we believe the IT impact is significant within our own operations footprint. Therefore, it should be part of our own operations targets and (CSRD) reporting. Especially scope 3 cannot be excluded since it captures the largest part of our IT emissions now with GenAI looming to add more impact.

The EED (Energy Efficiency Directive) for energy-efficient and sustainable Data Centres Data centres are responsible for about 1.5%, or 415 Terawatt-Hours (TWh), of the world's total yearly electricity consumption. Projections indicate that their **consumption is set to more than double** towards 945 TWh by 2030, primarily due to the substantial growth of energy-intensive accelerated computing, which is used mainly for AI purposes (source: [‘Energy and AI’](#) by the IEA and the EU).

To measure the energy consumption and the environmental and climate impact of EU data centres, greater transparency from data centre operators is key. The Energy Efficiency Directive introduced an obligation for the **monitoring and reporting** of the energy performance of data centres. “

Not all Datacentres are eligible for reporting according to this regulation, some conditions apply.

Main threshold: Installed IT power demand

A data centre falls under the mandatory EED reporting regime if it meets both criteria below:

1. Installed IT power demand ≥ 500 kW
 - Based on maximum rated power of IT equipment
 - Not total facility power, but IT load
 - Applies per site (not aggregated EU-wide)
2. The data centre must be:
 - Located in an EU Member State, or
 - Operated by an entity established in the EU and physically located in the EU.
 - No exemptions based on ownership nationality.

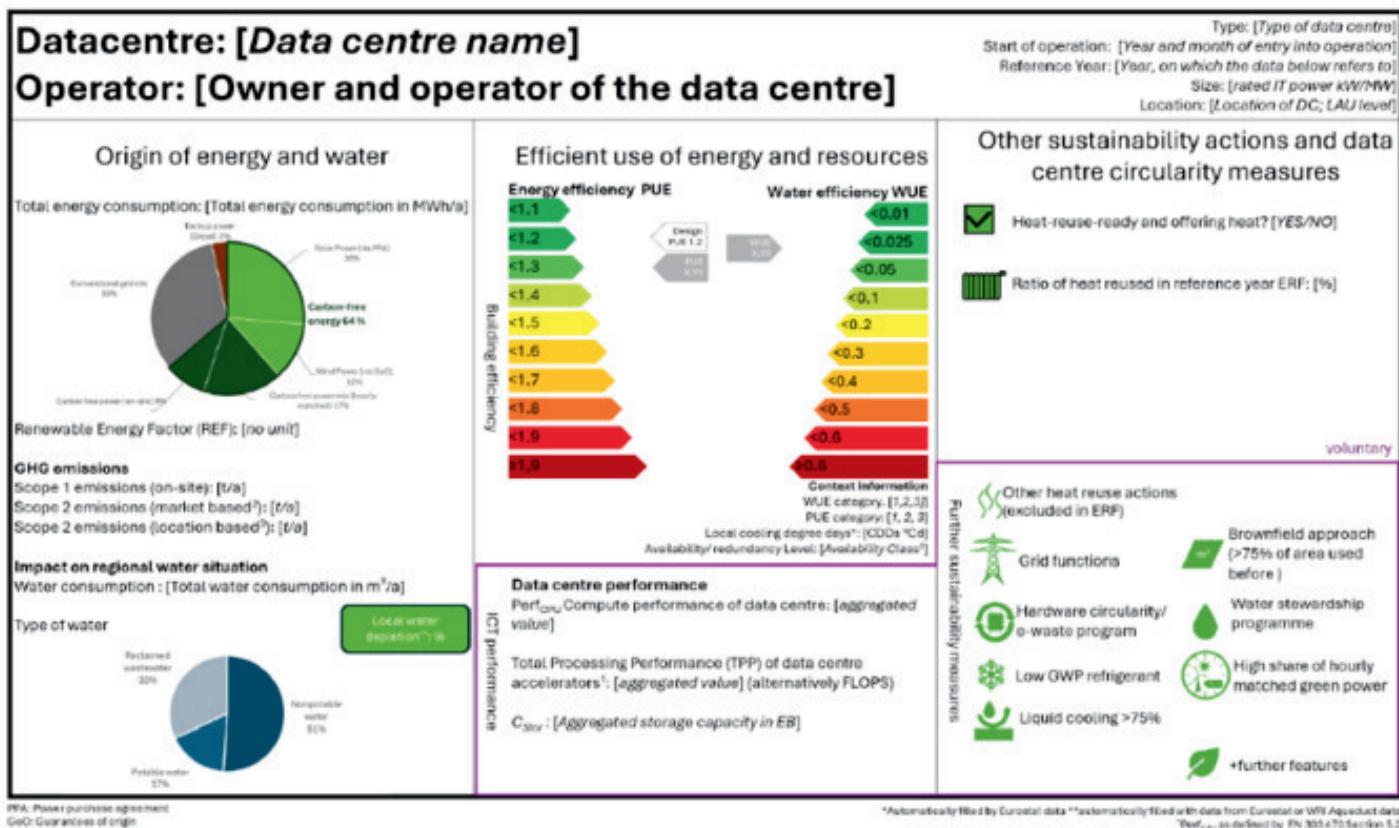
What obligations apply once in scope?

Mandatory data reporting (annual)

Cloud/Datacentre operators over the threshold must report via a European database, giving disclosure on topics like.

- Total energy consumption
- IT load and peak demand
- Power Usage Effectiveness (PUE)
- Water Usage Effectiveness (WUE)
- Waste heat recovery.
- Share of renewable energy
- Floor area
- Data traffic and storage capacity

The EED is translated into legislation by the member states – in the case of the Netherlands, see [Documenten en publicaties | RVO.nl](#).



Note. The above paragraph is derived with help of AI and based on sources: Article 12(1), Directive (EU) 2023/1791, European Commission Implementing Regulation (expected 2024–2025 guidance), Article 12(2) and Annex VII, Directive (EU) 2023/1791 See also the EC draft proposal for a data centre rating scheme.

More information: [Energy performance of data centres - Energy - European Commission](#).

ABN AMRO – Our own datacenters do not exceed the threshold but some of our suppliers DC do, we expect them to disclose information. Caveat, some eligible Datacentre/Cloud providers do report but show ‘confidential’ in the public version this undesired loophole exists in the EED regulation today.

Green Claims Directive

The Directive requires traders to provide clear, relevant and reliable information on the sustainable nature of the product and aims, among other things, to address the following practices:

- misleading environmental claims ("greenwashing").
- misleading information about the social characteristics of the product or the traders' businesses (such information may relate, for example, to the quality of working conditions, respect for human rights or environmental performance).
- non-transparent sustainability labels; and
- practices associated with the early obsolescence of goods (or, in other words, commercial policy involving deliberately planning or designing a product with a limited lifespan so that it prematurely becomes obsolete or non-functional after a certain period or after a predetermined intensity of use).

Source/More information: [EU Directive 2024/825 as regards empowering consumers for the green transition](#)

Reporting for in-company goals

When company goals are set and the organization want to communicate, they can always voluntarily disclose an environmental report about their goals and progress.

Voluntary Reporting: VSME

“The European Commission triggered the development of a voluntary sustainability reporting standard for non-listed micro, small and medium enterprises (VSME).”

It stems from the market need to have a simple reporting tool to be used by SMEs to face growing sustainability data requests from business counterparties (i.e. banks, investors or larger companies for which non-listed SMEs are suppliers) in an efficient and proportionate manner as well as to facilitate their participation in the transition to a sustainable economy. Based on market acceptance, the VSME is expected to standardise the current multiple ESG data requests (which represent a significant cost of preparation for non-listed SMEs), by reducing the number of uncoordinated requests they receive.”

More information: [Voluntary reporting standard for SMEs \(VSME\). Concluded | EFRAG](#)

Offsetting

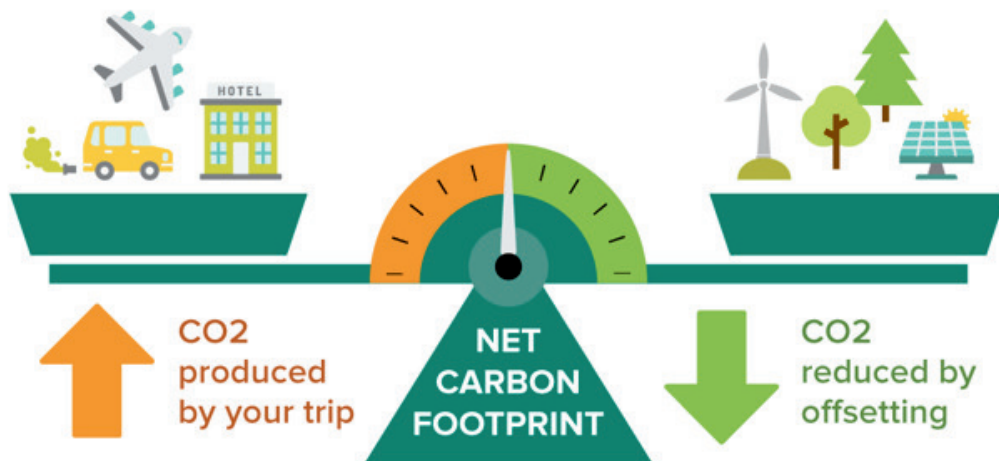
Carbon offsetting is truly a world of its own especially if you would also take into account controller policies or obligations (not done here). The main question is what is the quality of the offsetting, how strong is the evidence it really avoided or removed carbon emissions for a long period of time?

To avoid double (carbon) accounting it is also more and more needed to understand who applied what (quality of) offsetting when and for what?

- Will that indeed cover/compensate part of the/your footprint?
- Is the quality/evidence of the offsetting sufficient?

This paper does not cover offsetting into detail but below are some explanations on offsetting.

CARBON OFFSETS ALLOW YOU TO BALANCE OUT YOUR EMISSIONS



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Source/More information: [Carbon Offset Programs: The Complete Guide \[2025\]](#)

Types of Carbon Offset Projects

Carbon offset projects come in many forms, but they all have the same goal: to reduce or remove greenhouse gas emissions that drive climate change.

Avoidance vs Removal Projects

Carbon offset projects fall into two main categories: avoidance and removal. Avoidance projects prevent future emissions from occurring—for example, building a wind farm to replace fossil fuel energy or protecting forests from being cleared. On the other hand, removal projects draw down carbon already in the atmosphere through methods like reforestation or direct air capture.

HOW CARBON OFFSETTING WORKS

Carbon offsetting allows you to balance out your climate impact and compensate for the emissions you produce by reducing CO₂ elsewhere:

Carbon emissions are generated by air travel, lodging, transportation, dining, and other trip activities.



You purchase carbon offsets from Sustainable Travel International equivalent to the amount of CO₂ you produced.



These projects reduce CO₂ and other greenhouse gases by removing existing CO₂ from the atmosphere or preventing new emissions.



One project may build a wind farm that reduces reliance on fossil fuels

Another may engage farmers in sustainable harvesting to protect trees that absorb CO₂

Your contribution funds certified projects that conserve and restore forests, generate clean and renewable energy, or increase energy efficiency.



 SUSTAINABLE TRAVEL INTERNATIONAL

Source/More information: [Carbon Offset Programs: The Complete Guide \[2025\]](#)

A few more related concepts are briefly explained below.

Additionality

“What is additionality in carbon offsetting? ‘Additionality’ is a way to assess whether an activity provides something new or ‘additional’ – whether the activity has an impact when compared to a baseline.

In carbon offsetting, that impact refers to the carbon benefit of a project – the amount of carbon emissions reduced or removed as a result of the project.”

Source/More information: [What is additionality in carbon offsetting? And why is it important?](#)

Insetting

What is Carbon In-setting and how does it differ from Carbon Offsetting?

Carbon in-setting and carbon offsetting are extremely similar, with the exception that carbon in-setting involves efforts to reduce carbon footprints inside the structure of the value chain. For example, in Offsetting companies can buy carbon credits from a 3rd party to "reduce" their carbon emissions. For Insetting companies need to find a solution to reduce emissions within their value chain itself, instead of relying on a 3rd party.



Source/More information: [Moving from a carbon off-setting to a carbon in-setting mindset - I by IMD](#)

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For IT the world of Offsetting (within the IT landscape) is still an open field that we need to investigate further. More supplier information is needed to accommodate for the complexity and questions above.

NCDD: offset quality and double-counting need shared definitions before IT can rely on them. The quality of offsetting is a broad, cross-sector issue; the NCDD can contribute through knowledge sharing rather than solving it from within the ICT sector alone.

This final part brings the paper together. First what the ABN AMRO practice shows to be feasible and where we still have work to do, with a pointer to the paragraph where the topic is described. Then the part of the challenge that no organization can solve on its own and what we can pick up together in NCDD context.

Findings: what works, what is still missing and what is needed

The measuring and dashboarding of the IT footprint by ABN AMRO, described above, proved feasible and added value: it allowed us to explore, develop and realize this setup. The insights now help the organization to be aware, steer and report on the IT footprint.

What we are still working on

The practice above works for us but at the same time there are a number of open points, often already described earlier in this paper.

- Completing the coverage of the dashboard, software embodied and client sessions are acknowledged as categories and data is requested from our suppliers but not yet integrated in the dashboard, the 2026 KPI only covers 4 out of the 6 (or 8) IT footprint categories (see software embodied, see client sessions, see KPI's and OKR's)
- Progressing from spend based estimates to prime supplier data, for SaaS from contract value to actual expenditures, aligning the emission factors with the group sustainability department (Exiobase vs NACE) and enriching the data with contract mgt. tooling data (see method choice, see SaaS in the appendix).
- More depth in the steering on our on-premise infrastructure, low level steering information for DevOps teams is not there yet, for automating our embodied emissions data e.g. product carbon footprints we are now looking at data suppliers (see on-premise in the appendix).
- Measuring the electricity use of end user devices, we have not yet found the best way to read the actual power consumption of a laptop and other end user devices (see digital workplace in the appendix).
- Broadening the GenAI footprint, today we only have initial insights in the external LLMs we use, via Ecologits and also with its caveats and limitations. Metrics on embedded GenAI in (SaaS) software like Co-pilot or Office 365 are lacking, hence a clear data demand or obligation for the AI suppliers is needed (see GenAI embedded in SaaS, see GenAI in the appendix).
- Maturing the sustainability ratings, the S-rating (2020) and the GenAI sustainability rating (2026) are to be matured and/or adopted further (see the GenAI Sustainability Rating).
- Keeping the KPI reporting stable, merging all categories into one uniform table is harder than it may seem and changes in the underlying data lead to retroactive changes in KPI outcomes, a clear process for incidental but significant increases or decreases like an acquisition or divestment is still to be defined (see the OKR/KPI view in the appendix, see incidental changes in the appendix).

- Offsetting quality, for IT this is still an open field, and more supplier information is needed before we can integrate and rely on it (see offsetting).
- Assessing new technologies, new disclosed datapoints and new methods on what or when to adopt, the journey has not finished (see why this paper).

What is missing for consistent IT foot printing?

- Improvements are possible, needed and acknowledged mainly in data harmonization, collection and data quality.
- Standardized IT carbon accounting frameworks
- Limited availability of supplier data (esp. Cloud & SaaS)
- Market-based vs location-based inconsistencies
- Gaps in Scope 3 (especially software & supply chain)
- Immaturity of GenAI footprint measurement

NCDD: The NCDD can assist by

- Harmonization on the way IT footprint or wider impact is measured in the Netherlands, a guiding role from NCDD assist in this challenge.
- Explaining core principles around Market/Location based measuring.
- Addressing and demanding for the primary data still needed from the sector and/or governmental support to obtain this data, especially Scope 3 and AI footprint data, to prepare for more stringent scope 3 GHG reporting requirements.

Next to these the paper points at a number of areas where a coordinated national effort (See the NCDD roles highlighted throughout this paper) would help the sector forward.

- Harmonization and comparability, a shared reference model of where IT emits together with harmonized methods and GHG/IT scope definitions, so organizations can start measuring consistently and become comparable.
- Standards and maturity, helping the sector to select, harmonize, use and promote a de-facto Sustainable IT standard, to converge on one Green IT maturity model and to establish shared non-functional sustainability ratings like the S-rating.
- Bundling the market demand, aggregating the data demand of Dutch organizations towards suppliers, cloud and SAAS providers, including the granular location-based data that is missing today, and articulating what organizations actually need.
- Comparable AI data, using the NCDD workgroup on GenAI that starts in 2026 to demand transparent and comparable footprint data on AI services, including the GenAI embedded in standard software.
- Offsetting, sharing information on the quality of offsets so IT can rely on them before using them in its own reporting; double counting is a broader, cross-sector issue that reaches beyond the ICT sector.

- Best practices and assurance, entering into dialogue with accountants and IT auditors to standardise external reporting on the IT footprint in the annual report, based on what they see and expect, while guarding both the effectiveness of the measures and their practical feasibility.
- Knowledge sharing and scaling, making practical experiences like this ABN AMRO use case available so other organizations do not have to start from scratch.

NCDD Conclusion: from measurement to collective action

Measuring the IT carbon footprint is no longer a niche exercise—it is becoming a fundamental capability for organizations aiming to operate sustainably in a digital society. This whitepaper has shown, through the practical experience of ABN AMRO, that it is both possible and valuable to structure, measure, and steer the environmental impact of IT across domains such as cloud, workplace, datacentres, and software. At the same time, it has become clear that current measurement practices are still evolving and often rely on a combination of methods and (proxy) data.

The key insight is that organizations should not wait for perfect data or fully standardized approaches. Progress can already be made by combining available methods—such as various GHG protocol-based accounting methods, lifecycle analysis, and spend-based estimations—and by organizing data into meaningful dashboards that support Internal decision-making and external reporting. Early movers demonstrate that measurement itself is a powerful driver for awareness, governance, and behavioural change within IT organizations.

However, this whitepaper also highlights a fundamental limitation: individual organizations cannot fully solve the challenge of accurate and actionable IT carbon measurement on their own. A significant part of the footprint—particularly in Scope 3—depends on complex, global supply chains and large technology providers. Data is often incomplete, inconsistent, or not comparable, and key insights (for example on cloud usage, SaaS, or emerging technologies like AI) are not yet sufficiently transparent or standardized.

This leads to an important conclusion: improving IT carbon measurement is not only an organizational challenge, but a systemic one. It requires alignment across organizations, sectors, and countries, as well as stronger collaboration with suppliers and technology providers. Without shared standards, harmonized data definitions, and accessible reporting and auditing mechanisms, the ability to steer and benchmark on IT sustainability will remain fragmented.

The National Coalition for Sustainable Digitalization (NCDD) can play a crucial role in addressing this gap. By bringing together public and private stakeholders, NCDD is well positioned to:

- Facilitate alignment on measurement approaches and definitions
- Promote the development and adoption of (inter)national standards
- Aggregate demand from organizations to influence scope 3 cloud and hardware providers
- Enable knowledge sharing and scaling of best practices, such as the ABN AMRO use case
- Conduct a study on how large companies embed the IT footprint in their overall (CSRD) reporting

Looking ahead, the focus should shift from measuring footprints as an end in itself, to using these insights to actively steer IT choices and investments. This includes decisions on cloud usage, hardware lifecycle, software design, and the deployment of new technologies such as AI. Reliable data is a prerequisite—but also a catalyst—for this transition.

In that sense, this whitepaper is both a reflection of where we stand today and a call to action. Organizations are encouraged to start measuring, to learn by doing, and to collaborate openly. At the same time, suppliers, policymakers, and coalitions are invited to take responsibility for creating the conditions that make high-quality, comparable, and actionable data available.

Only through this combined effort can we move from fragmented measurement to meaningful action—and ensure that digitalisation contributes not only to economic and societal value, but also to a sustainable future.

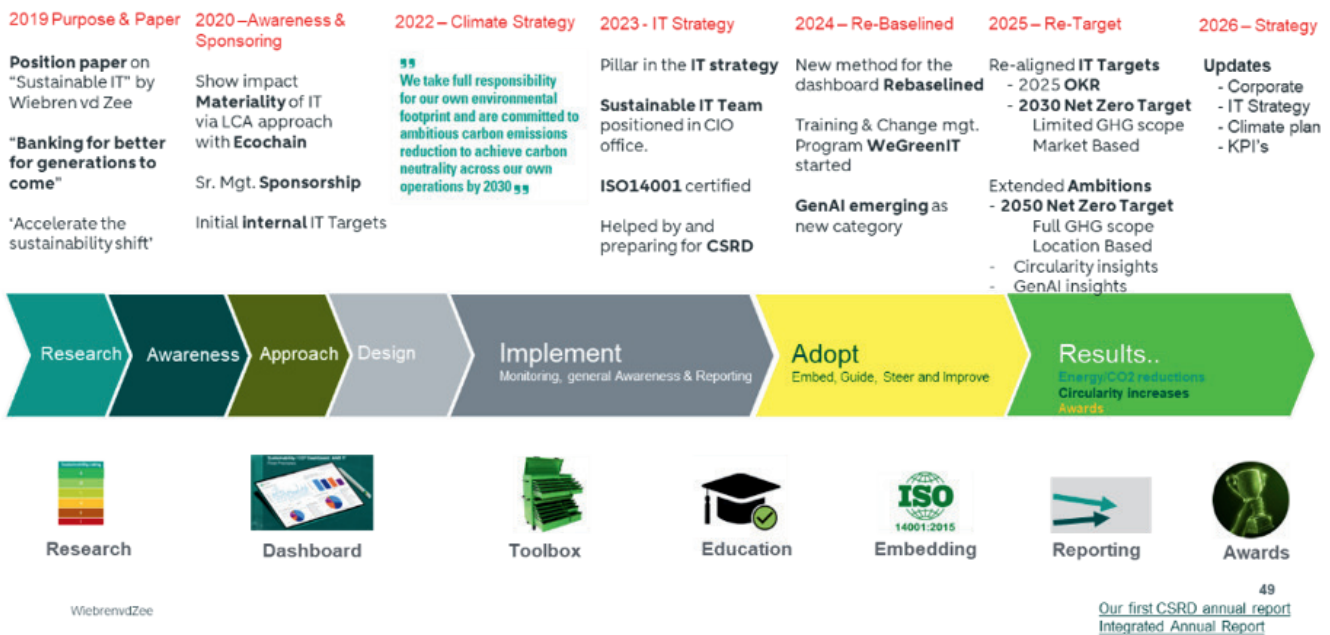
Appendices

From here the paper continues with additional material related to measuring.

The ABN AMRO Sustainable IT journey: embedding sustainability.

Over the past year we experienced a slow evolution adopting sustainability ‘non-functionals’ and best practices into our IT delivery and operations. From the position paper ‘kick-off’ in 2019 to the embedding the topic in the 2023 IT Strategy took around 4 years.

Summary: Sustainable IT @ ABN AMRO



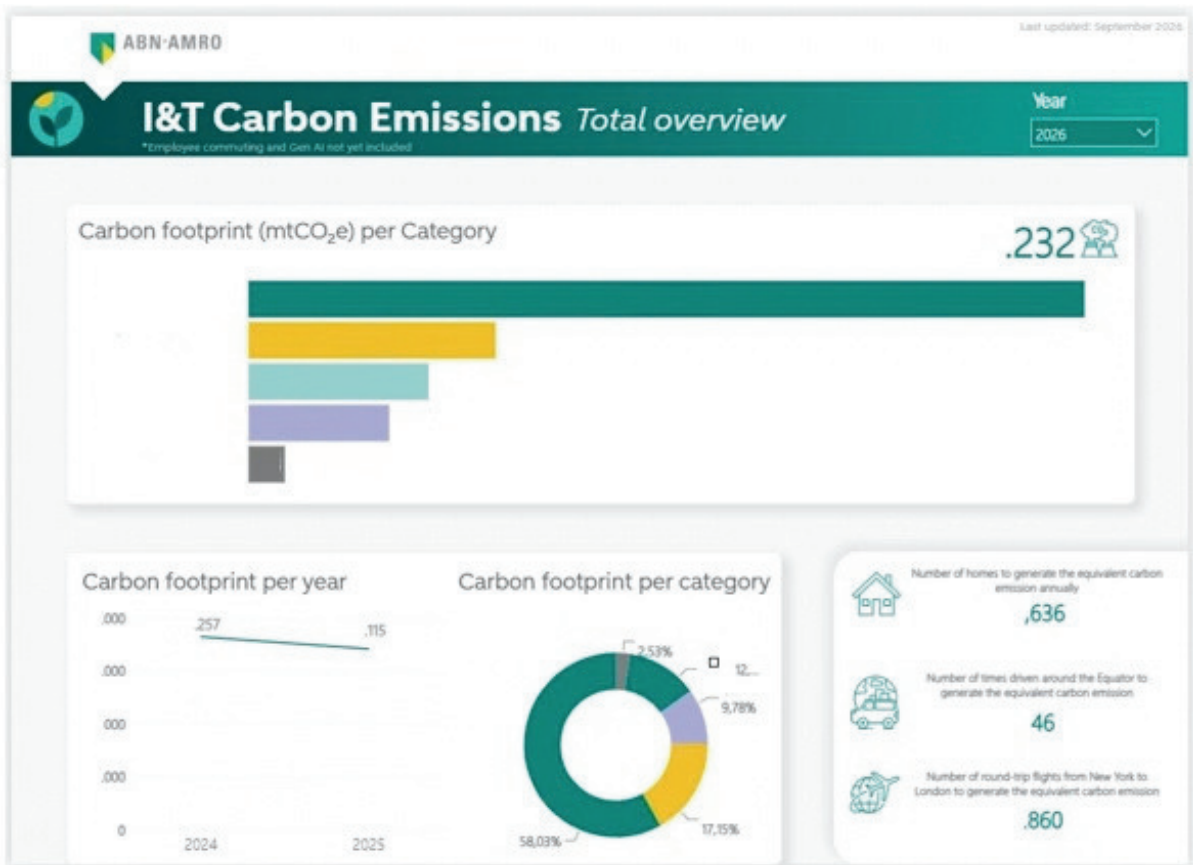
We started measuring our footprint based on an annual footprint analysis based on LCA models in cooperation with [Ecochain](#). To dive deeper into the details, we have setup a (data science) team in 2021 to constantly measure our footprint, the team is guided by a product owner (Jasper Behnken), underneath he wrote a reflection about the past years.

A Product owners’ journey on creating the Sustainable IT dashboard.

“The starting point for our dashboards was when we received budget via a proof of concept (PoC) based on the Cloud Carbon Footprint (CCF) calculator from the organization Thoughtworks, which was presented to the management team. If Sustainable IT is found important or even part of the IT strategy, it is probably also possible to engage a data & analytics team that supports the organization with dashboarding. If it is not part of the strategy, try to get it included, when you succeed it makes it easier to get support from other departments.

We started with the off-premise datacentres (Public Cloud) category, measuring both market-based and location-based emissions via the cloud carbon footprint (open source) software. At the request of the Azure platform team, we switched to using Microsoft data for official reporting, because this makes us more comparable with our peers. Location-based emissions are now indirectly derived from Microsoft’s market-based data and Microsoft’s environmental report (based on the EMEA region, which is the lowest level at which Microsoft provides insight). Obviously, it would be better if we could access this data for the Netherlands or North Holland. A -drawback- is that their report is published in mid-year, while our own fiscal year runs from January to December. Currently a significant increase in Microsoft’s emissions for EMEA is visible, which impacts our reporting. Such an increase is always difficult to explain. That is why we are now looking at external parties that can provide daily location-based and kWh data at the resource/application level, such as via GreenPixie.

A business travel dashboard was built for IT and later expanded with data for the entire bank. The advice is to include seasonal effects in the target line and reporting. We also developed our own Excel tool to estimate emissions from planned travel for the entire year. This, in combination with contacts per department and a specific KPI, worked very well and contributed to achieving an ambitious target in 2025. The dashboard was recently transferred to the group sustainability department. In hindsight, it would have been better to place it there directly and to document the dashboards better, with design choices clearly explained. A suggestion is to design dashboards together with Finance when CO₂ and costs are reported together. Finance may use a different organizational structure than HR, which can affect CO₂ reporting per department.



A screenshot of (one of the views of) the ABN AMRO - Sustainable IT dashboard.

Mobility has been placed with the group sustainability department, and emissions were calculated based on total mobility emissions and the number of IT employees.

On-premise (owned datacentres), we started with measured electricity totals and converted them to CO₂ based on carbon intensity, assuming (based on research) 20% for embodied emissions. Challenge: there is not yet enough low-level steering information for DevOps teams, and there is also no steering on embodied emissions when hardware is replaced. A lot of time was spent searching for Product Carbon Footprint (PCF) documentations; hence we are now looking at data suppliers such as Rejoose or Resilio.

SaaS, we applied the spend based method via contract value and duration, and a coefficient for IT services from the Exiobase database. We are now working on switching to actual expenditures. Discussions and alignment with the group sustainability department are ongoing on calculating the scope 3 emissions from purchased goods and services as they tend to use emission factors from NACE. The next step is to enrich the data with internal TPR tooling data, such as the percentage of green electricity used by suppliers, and to start asking Tier 1 suppliers whether they can provide emissions data for our use of their services—preferably via an API, otherwise via a contract mgt. tool (Helios).

With Digital workplace we engage about calculating estimated laptop electricity consumption. We have not yet found the best way to read electricity usage (hence scope 2) from devices real-time. Our laptops register battery capacity and not the electricity consumption via the power adapter connected to the wall socket. We use well-known software to monitor laptop performance, yet it provides power figures that do not match our own measurements. For embodied emissions, a lot of time was spent searching for PCFs, here as well I am now looking at APIs from OEM suppliers or data service providers like Resilio or Rejoose.

We have started gaining insight into GenAI. At the moment, this is only for the external LLM we use. For this, we use the open-source tool Ecologits, this approach still has its limitations but provides a starting point.

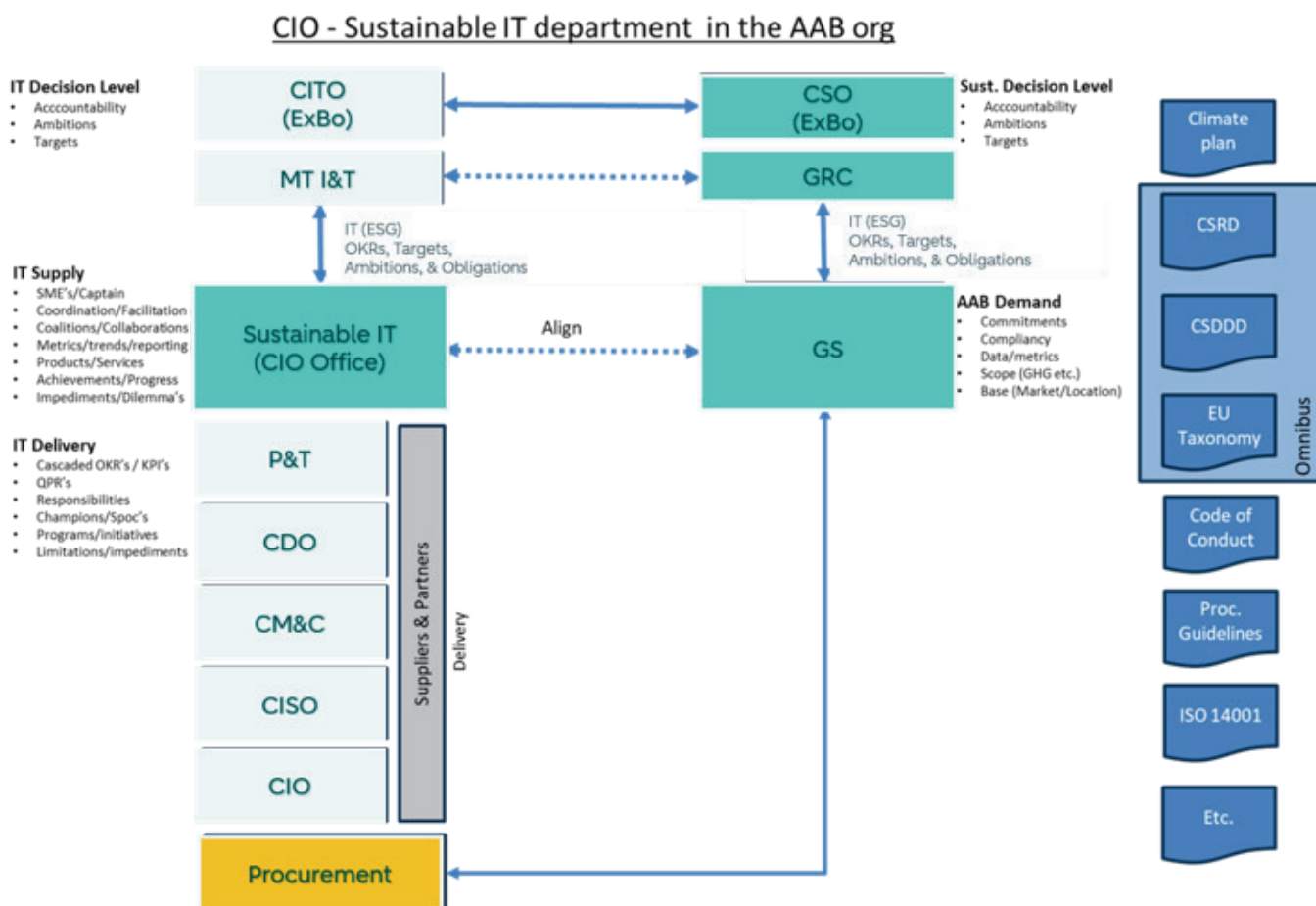
We create an OKR/KPI view that is fed by all the above categories. Merging all the data into a uniform table is harder than it may seem. Changes in the underlying data sometimes lead to retroactive changes in KPI outcomes, which results in a lot of investigation work. For example, when we switched from the Microsoft beta API (Impact Dashboard) to the new, more stable Carbon API, this led to an approximately 2% increase in emissions. It turned out that the old API did not report all consumed services due to a limitation. As a result, the final step for reporting to the management team is still done manually, we aim to use the OKR/KPI view eventually.

Finally, we are working on defining a process for dealing with incidental increases or decreases, for example due to an acquisition or divestments. This affects both KPIs and long-term objectives.”

Source: Jasper Behnken – ABN AMRO Product owner Sustainable IT dashboard

Sustainable IT in the organization

Our sustainable IT team sits within the IT Column, sponsored by a C-level member and is the prime liaison towards the central Group Sustainability department.



Other Methodologies (to measure the footprint of IT)

Methods not further handled in this document, but interesting to explore (for the NCDD)

ITU-T L.1470

Summary Recommendation ITU-T L.1470 provides detailed trajectories of greenhouse gas (GHG) emissions for the global information and communication technology (ICT) sector and sub-sectors that are quantified for the year 2015 and estimated for 2020, 2025 and 2030. In addition, Recommendation ITU-T L.1470 establishes a long-term ambition for 2050. The trajectories, the long-term ambition and the 2015 baseline have been derived in accordance with Recommendation ITU-T L.1450 and through complementary methods in support of the 1.5°C objective described by the IPCC in its Special report: Global warming of 1.5°C and in support of the Science-based Targets (SBT) initiative.

[L.1470: Greenhouse gas emissions trajectories for the information and communication](#)

Note: Also see the earlier SAAS/AP chapter for GenAI ITU approach

EGDC

To support the Green and Digital Transformation of the European Union [1], the EGDC developed a science-based methodology to assess the net carbon impact of ICT solutions*. This methodology allows to identify ICT solutions that can deliver a net positive impact by reducing emissions outside of the ICT sector.

Net Carbon Impact Assessment Methodology for ICT Solutions - European Green Digital Coalition

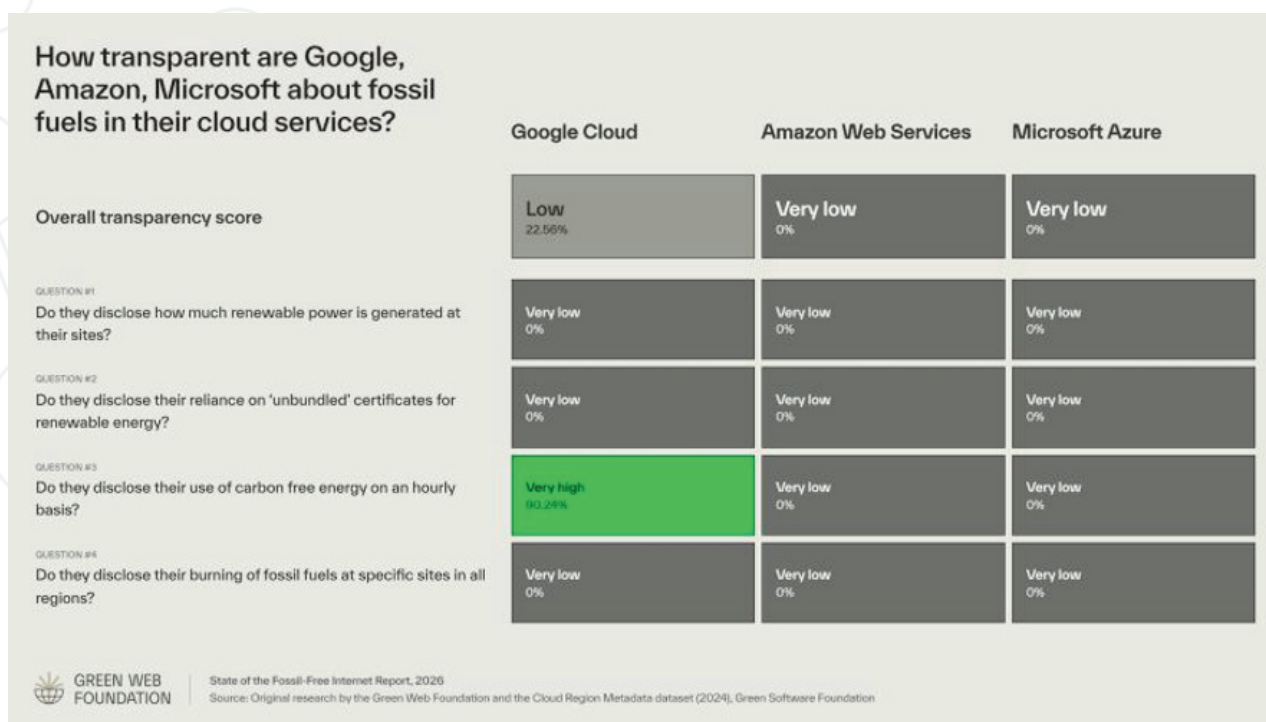
Overview of dashboard data service providers

A limited overview of some key (data) players that can help to deliver data/calculations to enrich your insights, dashboarding or reporting.

- [GreenPixie](#)
- [Resilio](#)
- [Rejoose](#)
- [Greenspector](#)
- [Ecochain](#)
- [TCO certified](#)
- [Ecologits](#)
- [Electricitymaps](#)
- [Sopht](#)
- [Mykuji](#)
- [Conclusion](#)

Transparency of cloud providers

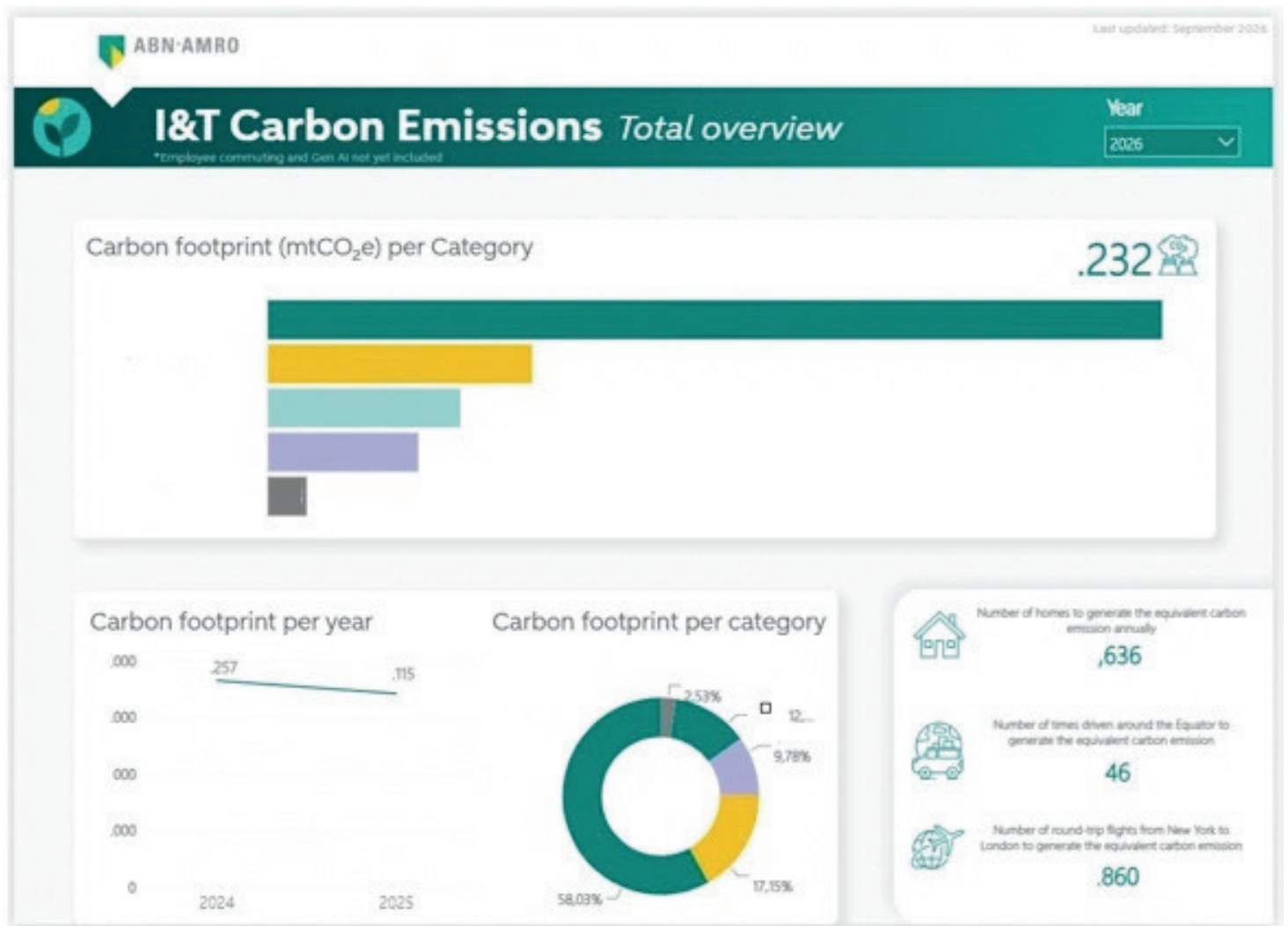
Research about the impact transparency of cloud providers has been done by the Green Web Foundation, more background can be found [here](#).



Source/More information: [State of the Fossil-Free Internet Report](#)

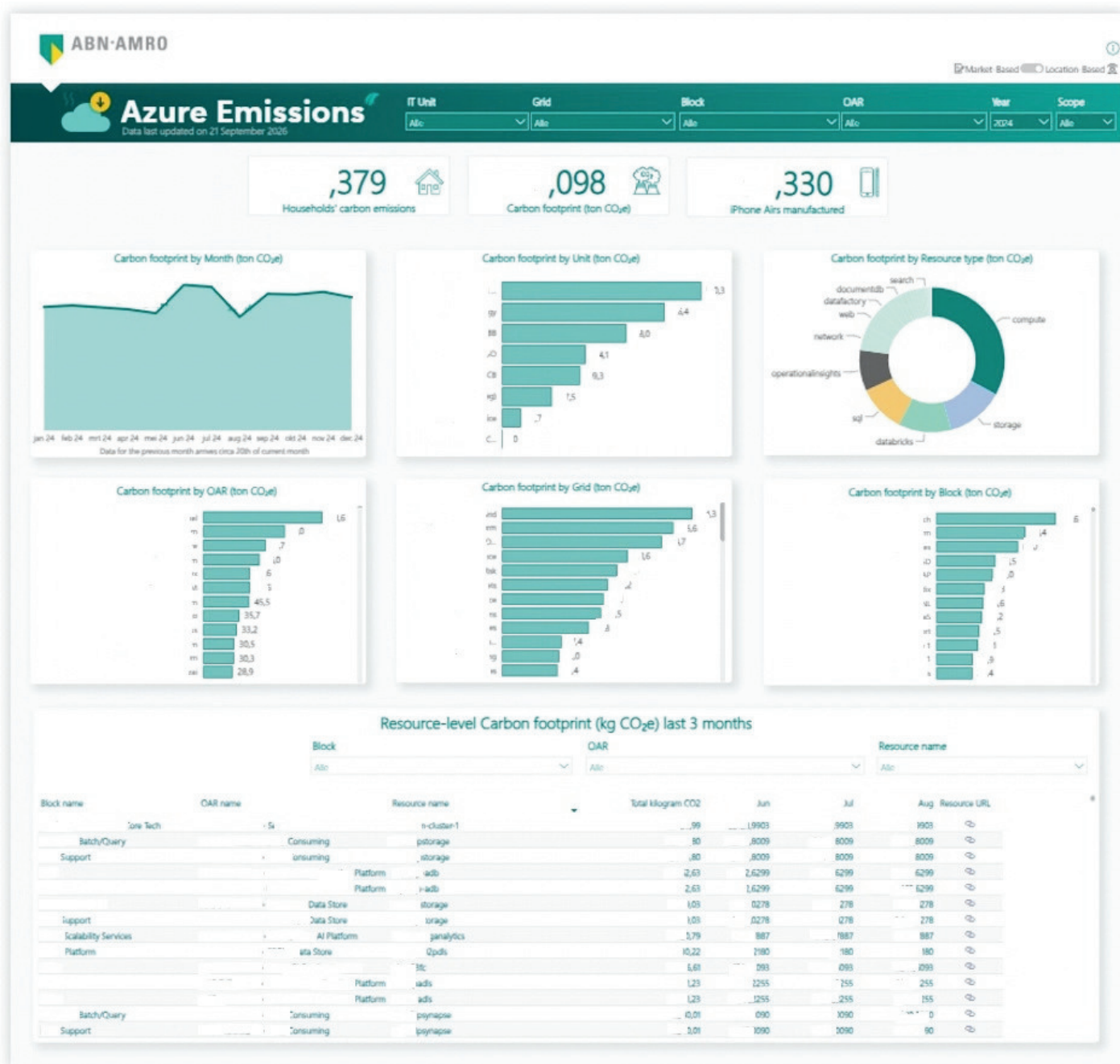
Dashboard view examples

Total/aggregated view.



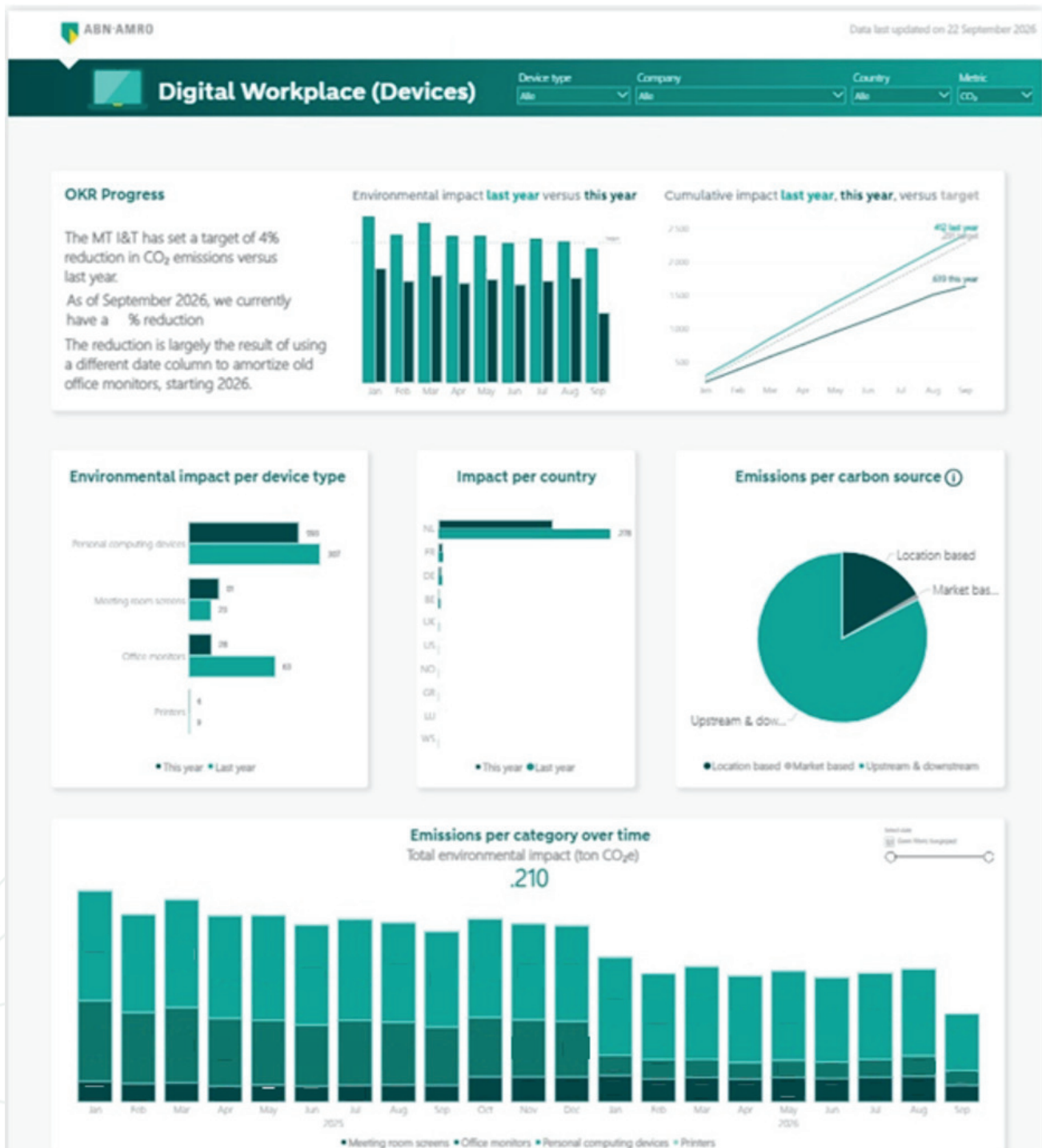
Note: All values are illustrative only and do not provide ABN AMRO actuals, some details are blurred for sensitivity.

Off premise view (Azure)



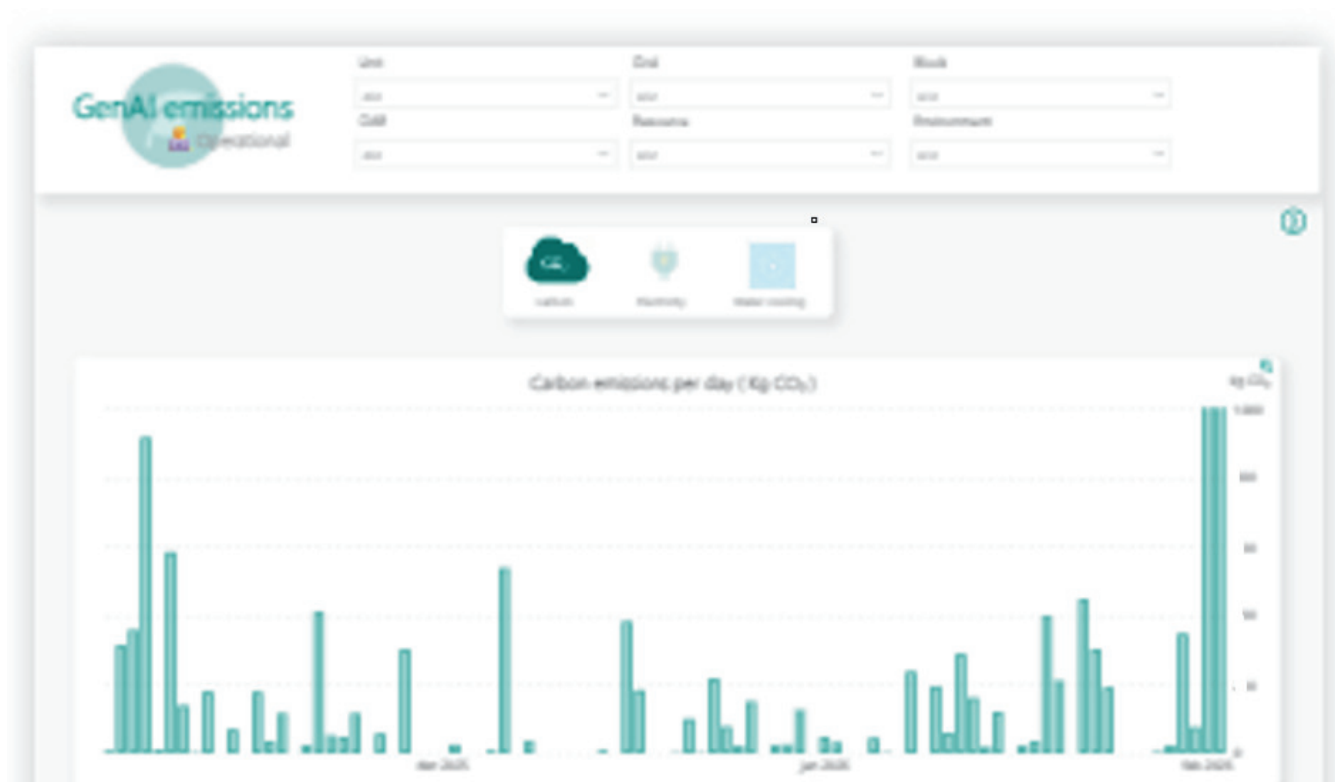
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Digital Workplace view

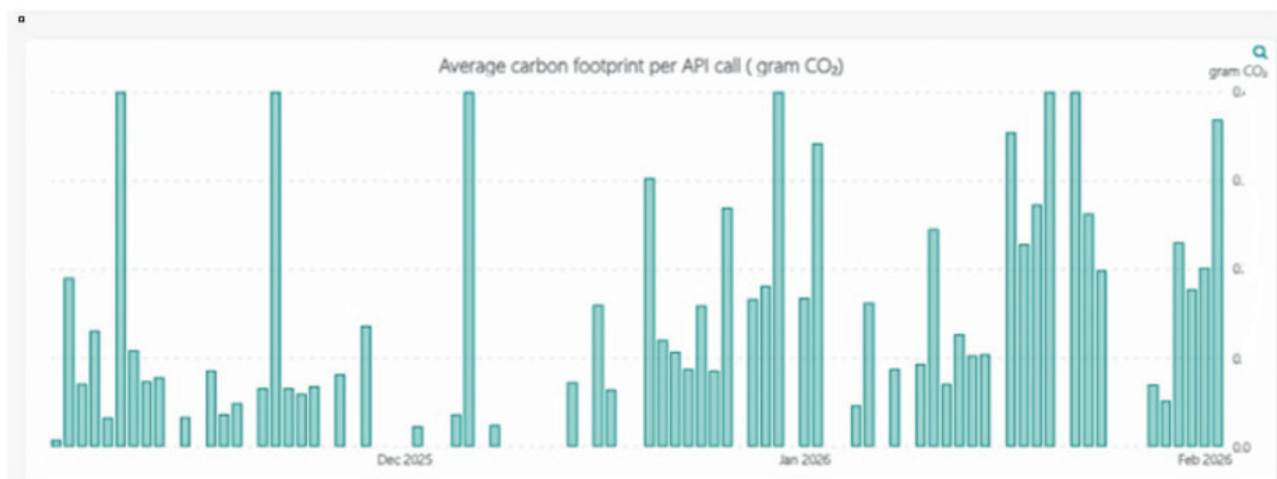


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GenAI view



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S-rating – resource dynamics



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