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THE IMPACT OF AI ON THE ENVIRONMENT

MomentumAI Sustainability Report I

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

- AI has a large environmental impact over its entire lifetime, including the life-cycle of the physical materials used in chip production and data centre construction, and the energy and water intensiveness of these data centres throughout both training and inference phases
- The calculation of the entirety of the environmental impact of a single model is complex, and requires a comprehensive methodology
- Mitigation and compensation of the environmental impact is fraught, and needs to be done via an accredited vendor via sufficient, scientifically-robust methods
- MomentumAI intends to lead approaches to sustainable AI usage, and it will do so by tracking user emissions, informing users, and offsetting these via high-level carbon offset schemes that leverage carbon removal methods
- Quarterly reports will demonstrate MomentumAI’s ongoing commitment to mitigating the environmental impact of the AI industry, alongside other measures described within the Report.

INTRODUCTION

It is 2025, and climate change is now a very well-observed global phenomenon. Its causes are diverse, but include to a large extent energy production. Energy, in turn, is used for the electricity, heat and mobility that drive essentially all social and economic activity of the 21st Century. This encompasses everything from cooking and lighting to modern space travel, manufacturing, and the large infrastructural networks that facilitate communication, work, research and the digital realm.

It is in this context that artificial intelligence (AI) is being integrated into the global economy. AI bears an environmental toll in a host of ways, pertaining not merely to the electricity use of a single query, but also to the life-cycle of materials used to construct the servers and data centers which power the millions of neural-network paths. It is essential for this to be recorded and accounted for in the international effort to mitigate the effects of climate change.

MomentumAI commissioned this report to establish a transparent, science-based approach to measuring and mitigating the environmental impact of AI usage on our platform. Working with independent researcher Thomas Brcic (LLM in Energy and Climate Law), we have developed both a comprehensive understanding of current AI environmental impact and a concrete implementation strategy for sustainable AI deployment. This report provides an overview of the environmental effects of AI and establishes MomentumAI's approach toward transparent and sustainable AI usage. In section A, it will first detail the most up-to-date understandings of the environmental impact of AI, building on scientific insights from a range of global political, economic and research institutions. Section B will then provide an overview of proposed and utilised methodologies for the calculation of this impact, from full life-cycle assessments (LCA's) to single-query granularity.

Finally, Section C and D will reflect on the viability of reconciling wide-scale AI usage with global and national environmental ambitions, including the responsibilities this could entail for all stakeholders in the AI industry.

Transparency is paramount to the future of responsible AI deployment. MomentumAI is committed to leading this effort.

SECTION A

The effect of AI on the environment

(regjeringen.no)

The net effect of AI on the environment can be understood as the cumulative calculation of the positives and negatives. To seriously understand both how (1) individual frontier AI developers, and (2) the AI industry as a whole affect our living world, every single factor must be taken into account. This section will briefly compile the findings of existing research to generate a simplistic overview of the landscape.

Positives:

- Data pattern recognition can be used to predict environmental phenomena and help all societal stakeholders make choices that reflect this increased oversight
- Can enhance efficiencies; used by organisations, institutions and businesses that pursue environmental goals. The United Nations Environment Programme (UNEP), for example, uses AI to detect methane leaks from oil and gas installations (a greenhouse gas central to climate change)
- Could lead to more efficient online searching - ie a response to a query made via an LLM may have required more searches to reach via ordinary search-engines, and thus could reduce energy expenditure.

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Negatives;

- Large-scale AI models rely on servers that are housed in data centres. Data centres, firstly, require electronic equipment - as an example, 800kg of raw materials are used in the construction of a 2kg computer. The microchips in these computers consist of raw-earth minerals that are often mined in environmentally destructive ways.
- These data centers contribute to electronic waste that is hazardous and growingly difficult to re-incorporate into circular economies
- Data centers are very water-intensive throughout construction and operation
- Data centres require a lot of energy, often sourced via fossil-fuels. This comes at the expense of new aggregate demand, which displaces efforts to green the existing demand. This means that even if new demand is met sustainably, there is reduced overall momentum towards changing the overall energy mix in the transition from fossil-fuels to renewables. This is problematic in consideration of the fact that some estimates posit that ChatGPT - a popular LLM - consumes electricity equivalent to 10 Google searches on average per one input.
- Training runs of frontier models require extensive energy, whose energy and environmental effect is compounded by the continual release of new consumer-facing models requires
- AI can be used in the spread of misinformation about climate change, downplaying the threat and purporting unscientific political narratives. This is deemed a higher-order effect.

A conclusion on the net effect of AI on the environment is near-impossible, as it would require weighing the above described effects against each other. The idea that these effects sit on a spectrum from speculative to already realised further complicates the picture. Nevertheless, the existence of significant negative externalities demands immediate action, which is why MomentumAI has commissioned this report and developed the implementation strategy outlined in Section D.

SECTION B

Impact Measurement

This section is divided into (1) theory and (2) practice.

Theory

The total impact measurement of AI on the environment comprises a series of separate considerations. It is arbitrary to consider merely the impacts of a single-query in the context of the entire life-cycle of an AI model, and both should thus form the subject of comparison. This section categorises environmental impact in a way that is congruent with state-of-the-art approaches, in particular, the categorisation advanced by the International Telecommunication Union in its Green Digital Action effort.

Existing assessments have categorised measurements into two categories; software life-cycle and hardware life-cycle:

- Software life-cycle (or usage impacts) accounts for the collection of data and preparation, model development, training, validation, deployment, inference, maintenance and retirement
- Hardware life-cycle (or embodied impact) accounts for all raw materials and production/construction involved in the physical infrastructure. This includes graphical processing units (GPUs) production, data centre construction and operation, raw material extraction/manufacturing/shipping and maintenance and disposal. The disposal of e-waste likewise forms part of this calculation.

Likewise, the following phases have been identified as valid points for distinguishing between different types of impact:

1. Training
2. Inference
3. Supply Chain

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1. **Training Phase**

Whilst existing methodologies are inadequate and overreliant on estimations - due in part to inadequate corporate disclosure - existing best practices involve the following calculations.

For Energy consumption (KwH), the following is used most often:

Energy (kWh) = GPU power draw (kW) × Training time (h) × Utilization rate

Nevertheless, this doesn't account for the reality that GPU is not the only computing component involved in AI training pipelines. CPUs, networking devices, memory modules and storage systems form additional components that are thus unrepresented in this calculation.

To convert this into carbon emissions:

CO2e (kg) = Σ [total system energy (kWh) × Data centre PUE × Grid emission factor (kg Co2e per kWh)]

PUE refers to the power-usage effectiveness of data centres, and the grid emission factor accounts for the fact that emissions vary in different locations. For example, some grids may consist of electricity powered by fossil fuels (e.g. Poland's grid is 54% coal sourced), whereas others may be more renewable (e.g. Ireland's grid at 77%).

Furthermore, to include the expected usage volume of a model, training can be accounted for in the inference stage;

Per inference emissions = Training Co2e / Expected number of inferences

More calculations are used to estimate the effectiveness of water usage, and likewise more refined understandings of data centre PUEs. Again, however, it is important to underscore the shortcomings of the existing attempts at estimating the total environmental effect of the training phase.

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These are;

- Telemetric data is substituted by estimates and proxies due to undisclosed data.
- Boundaries of the 'training phase' are inconsistent.
- Units are not standardized to either token, training cycle, user session, etc.
- CO_2 emissions are the main focus of studies, whereas environmental effects can manifest from water use, resource mining and use, biodiversity impacts and waste.

2. Inference Phase

This is the operational deployment stage of an AI model, and measurement of environmental impact is particularly crucial to LLM-powered chatbots, including generative AI.

For calculating the energy per inference (Wh);

(Wh) = Total runtime energy (Wh) / Inference count

More refined measurements, however, can be found via

Energy per token (Wh) = (Power x Inference duration) / (Number of tokens × 3600)

In the comparison of different hardware and model architecture choices, the energy performance efficacy is also a valuable metric;

Energy efficiency score = Model accuracy / Energy consumed

3. Scope 3 Emissions

For comprehensiveness, Scope 3 emissions would also need to be considered. These are the emissions that are related to a company's value chain, though do not fall under the ownership of the company itself - for example, transport of parts to the places of construction and operation. For the sake of simplicity, this report won't account for these emissions. Nevertheless they can generally be narrowed down to embodied CO_2 emissions and recycling rates.

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Practice:

Whilst understanding the theoretical underpinnings of emissions calculations is important, operationalising this into calculations on the company/model level is more practical in respect to empowering consumers to make sustainable choices. This section will briefly present an overview of two existing estimate tools.

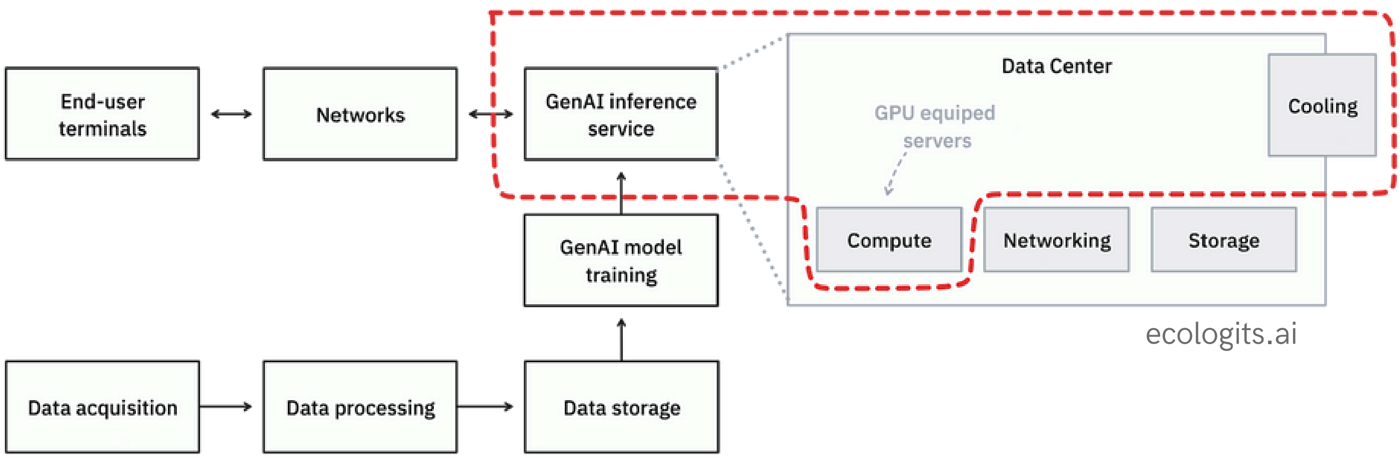
EcoLogits

EcoLogits is an emissions calculation tool created by GenAI Impact, a non-profit organisation supported by the Ministry of Culture of France. It employs an LCA methodology that is comprehensive, albeit not including end-of-life calculations due to limited data availability on the management of e-waste. Four environmental criteria comprise the subject of their assessment;

- Global Warming Potential (GWP)
- Abiotic Resource Depletion for Elements (ADPe)
- Primary Energy (PE)
- Water Consumption Factor (WCF)

Due to limited data provided by model providers, there are limitations to the approach of GenAI Impact. These pertain to;

- unspecified data centre location (only country specificity, not regional)
- unspecified data centre cooling methods or specific infrastructure
- lack of accounting of local electricity generation methods (including private power plants) specific to data centres
- lack of information regarding to cloud provider overhead costs
- training life-cycle considerations aren't included



ecologits.ai

Other

GAISSALabel is another tool similar to GenAI Impact's EcoLogits, creating labels that categorise AI models by their energy efficiency. Nevertheless, it hasn't yet catalogued all state-of-the art models available.

SECTION C

Mitigation and Compensation

Many businesses' efforts toward the mitigation of climate change are poor. This has led to the branding of the term 'greenwashing'. The United Nations describes it in the following way:

Greenwashing manifests itself in several ways - some more obvious than others. Tactics include:

- *Claiming to be on track to reduce a company's polluting emissions to net zero when no credible plan is actually in place.*
- *Being purposely vague or non-specific about a company's operations or materials used.*
- *Applying intentionally misleading labels such as "green" or "eco-friendly," which do not have standard definitions and can be easily misinterpreted.*
- *Implying that a minor improvement has a major impact or promoting a product that meets the minimum regulatory requirements as if it is significantly better than the standard.*
- *Emphasizing a single environmental attribute while ignoring other impacts.*

To pursue genuine climate change mitigation, MomentumAI has examined the failures of existing efforts to avoid greenwashing and ensure meaningful impact. One of the most popular methods of addressing the environmental impact of human activities is via 'carbon offsetting'. This is "the practice of using avoided emissions or enhanced removals to compensate for GHG emissions".

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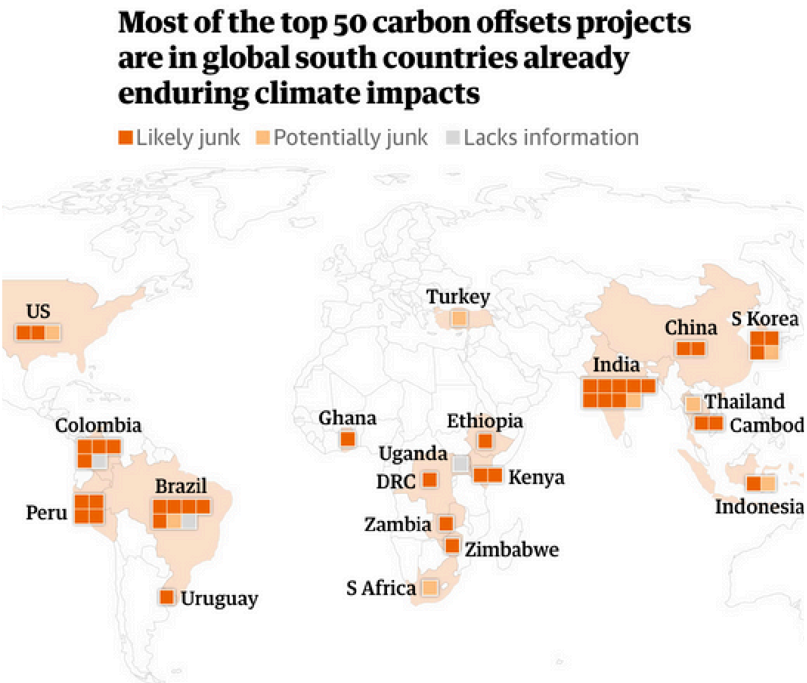
This can be positive, though attempts at it have often been lacklustre and thus can also be seen as greenwashing. Studies have found that most programs that claim they engage in effective carbon offsetting "overestimate their probable climate impact often by a factor of five to ten or more" and that "many of the most popular offset project types feature intractable quality problems". This is very problematic. It occurs due to a mixture of issues that arise from several core challenges, relating to;

- double counting of carbon credits
- additionality (whereby purchased credits formed part of already existing systems, such as a forest that had already been planted)
- leakage (due to several intermediary parties, or boundary shifting)
- environmental injustice
- verification issues
- permanence (as storage of carbon is unstandardised).

There are, as such, "relatively few types of high-quality projects", otherwise termed 'high-integrity'. These are confined mostly to the methodology known as Carbon Dioxide Removal (CDR) with permanent storage. Two main paths exist; Engineered solutions include Direct Air Capture (DAC) and Bioenergy with Carbon Capture and Storage (BECCS), whereas nature-based solutions consist in deforestation, biochar and enhanced rock weathering (ERW).



The Guardian (2023)

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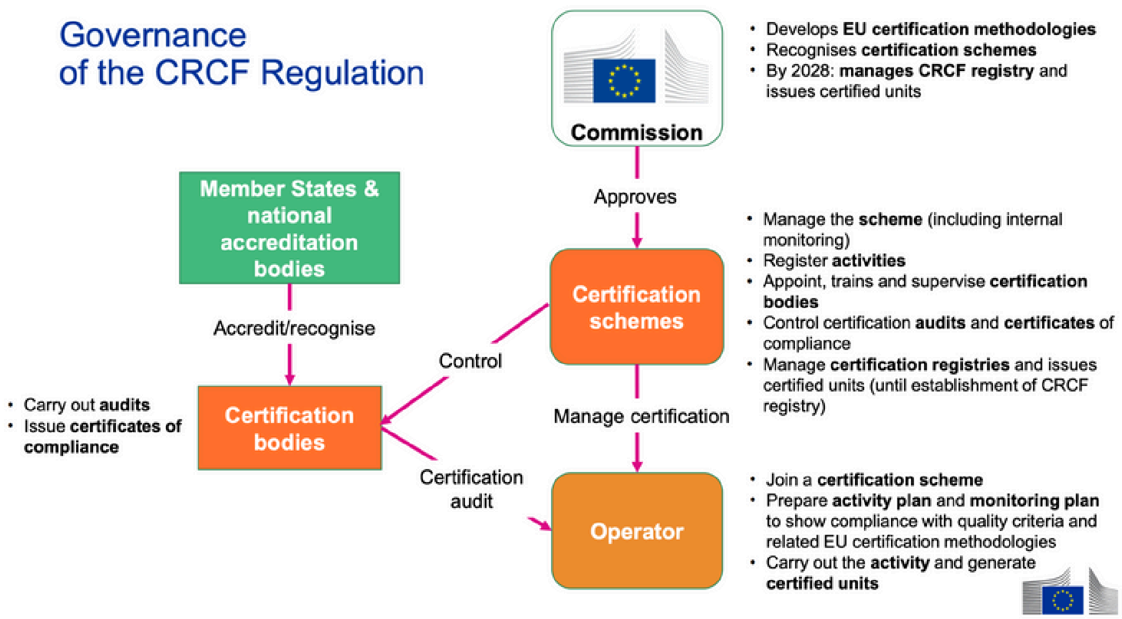
The EU Carbon Removals and Carbon Farming (CRCF) Regulation (2024/3012) of 27 November 2024 established a certification framework to address this. This advanced a standardised methodology for the calculation of many of the above points; including "baselines, monitoring periods, activity periods, additionality, leakage, non-permanence and liability, as well as [...] requirements related to authorisation and corresponding adjustments".

To be certified by the EU authorisation body, projects must meet the QU.A.L.ITY criteria - QUantification, Additionality, Liability, and sustainabilITY - and then be subject to independent verification.

However as of November 2025, the Commission has not yet created its registry of approved schemes or certifiable bodies, as the methodology is still being refined via proposed Delegated Acts. Nevertheless, credible projects with promise do exist.



European Commission (2025)

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Name	Type	Facts
Beccs Stockholm (Stockholm Exergi) beccs.se	BECCS (bioenergy with carbon capture & storage)	Swedish company, mix of public and private funding. European Investment Bank (EIB) has given a loan (~€260 M) for the project.
The Carbon Removers https://thecarbonremovers.com/	Biogenic CO_2 removal (engineered)	Secured a contract under Denmark's NECCS (negative emissions) fund. Participating in Project Greensand, for geological CO_2 storage in the North Sea.
Climeworks https://climeworks.com/	DACCS (Direct Air Capture + Storage)	Swiss-based pioneer of DAC. Operates several plants, including Mammoth in Iceland.
Greenlyte Carbon Technologies https://www.greenlyte.tech/	DAC (absorption-based)	German company. Uses a proprietary liquid-based absorption technology to capture CO_2, and also produces green hydrogen as a byproduct.
Carbfix https://www.carbfix.com/	Mineralisation / Geological Storage	Icelandic company that turns CO_2 into rock by injecting it into basalt formations: the CO_2 dissolves in water, enters basaltic rock, and mineralizes to carbonate minerals.

This report does not advocate for the efficacy of any of the above, though simply echoes them as potentially credible fulfillers of the EU's CRCF methodologies.

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Nevertheless, it is important to acknowledge that whilst carbon emissions aren't the single contributor to climate change - instead forming one of many factors - they are considered one of its most consequential. As such, carbon offsetting can be significant in its potential toward mitigating this global phenomenon, though it does little to repair other harms, including the unsustainable mining of many of the critical raw materials that are used in the production of hardware. This is, unfortunately, inherent to many of the primary materials powering global supply chains. MomentumAI remains alert and agile to developments in the reconciliation of AI with environmental protection. Examples include the EU's Strategic roadmap for digitalisation and AI in energy, which describes upcoming plans for EU data centres to receive data labels that will include information on the energy and water use of data centres. Such initiatives are welcomed and must be fostered by companies facilitating the wide-scale usage of AI. MomentumAI will therefore continue undertaking and supporting research toward more holistic means of reparation.

SECTION D

Communication Strategy & Implementation

To empower consumer choice in sustainable AI usage, transparent communication of environmental impact is essential. The challenge lies in integrating impact measurements in a way that is visible yet unobtrusive, informing users without disrupting their workflow excessively.

Current Implementation (Launch Version)
MomentumAI's first platform version includes the following sustainability features:
User-facing transparency:

- Model emissions display: gCO_2 emissions per million tokens shown for all available models, enabling informed model selection
- Comparison and filtering: Users can compare models side-by-side and filter for the most sustainable options
- Sustainable default: A "top pick" model that balances performance with environmental impact serves as the default selection (projected to influence 50%+ of user choices)
- Interactive methodology access: Users can click through to understand the emissions calculation methodology behind the displayed figures

Backend tracking and governance:

- Token tracking: Comprehensive monitoring of token usage across all users and models
- Sustainability officer: External auditor appointed to oversee environmental commitments and quarterly reporting
- Compensation commitment: Quarterly carbon credit purchases based on aggregated user emissions

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Near-term Development (Q1 2026)

The following features will be tested for implementation in the first quarter of 2026:

- High-impact nudges: When users request energy-intensive tasks (e.g., image generation, extensive multi-page outputs), a contextual prompt will appear: "Image generation is ~10× more energy intensive than text responses. Would you like to: Continue, Generate a lower-energy version, or Switch to text-only explanation?"
- Footprint summaries: periodic environmental impact reports at both individual and enterprise scales
- Carbon credit procurement: Purchase of carbon credits from vendors using methodologies aligned with the EU CRCF framework and CDR best practices, covering the upper-bound estimate of all user emissions

Long-term Commitments

Looking beyond 2026, MomentumAI commits to:

- Quarterly transparency reports: Beginning Q1 2026, public reports detailing total user emissions, carbon credits purchased, methodology updates, and progress on sustainability goals
- Evolving governance: Expansion of the sustainability officer role or engagement of additional independent third-party auditors to ensure continued accountability
- Methodology refinement: Continuous review and updating of emissions calculations as more accurate data becomes available from model providers and as EU CRCF certification frameworks mature
- Research and advocacy: Active support for industry-wide transparency standards and participation in research toward more holistic environmental impact measurement (including water usage, rare earth mineral impacts, and e-waste considerations)

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