



Greenhouse Gas Emissions Calculation Certification for the Dynatrace Cost and Carbon Optimization App

About the SDIA

Established in 2019, the Sustainable Digital Infrastructure Alliance e.V. (SDIA) is a non-profit network of more than 900 members and partners working to build a sustainable digital economy. The SDIA brings together stakeholders from across industries and fields, both public and private, to realize its Roadmap to Sustainable Digital Infrastructure by 2030 (sdia.io/roadmap). As an independent organisation, the SDIA offers a holistic, systems-thinking approach to solving the challenges facing ICT sustainability, ranging from energy supply and data centres to fibre-optic networks and software.

About the report

Dynatrace commissioned the SDIA to review, test, and validate the assumptions and calculations made by their Cost and Carbon Optimization app to estimate greenhouse gas (GHG) emissions. This report summarizes the findings and recommendations resulting from the engagement.

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Requirements

As part of the independent SDIA-conducted review, we evaluated the following key points for the Dynatrace Cost and Carbon Optimization app:

- The environmental impact indicators reported by the app
- The data sources used as inputs to the calculations
- The static assumptions applied to the calculations
- The accuracy of the Dynatrace agent host metrics
- The calculation formulas used by the app
- The testing and verification procedures used by Dynatrace
- The ability of the customer to independently verify that the reported information is correct
- The accuracy of the results across various cloud environments

Environmental impact indicators

Dynatrace's main output is the calculation of greenhouse gas (GHG) emissions; specifically, these are operational emissions from energy use by the customer's hardware.

Part of the calculations is the data center footprint. This is derived using the PUE value and, if available, the emission factor for that specific data center facility.

Data sources

The primary data source for the calculations is the Dynatrace OneAgent data, which is derived from resource utilization of the individual host instances: CPU utilization, memory utilization, network utilization, and storage I/O.

OneAgent data is converted and enriched using external data sources:

1. Energy emission data is sourced from the European Energy Agency and the Cloud Carbon Footprint tool to determine emission factors specific to cloud data center locations. This data is an annual average value.



2. Thermal design power (TDP) values are derived from AMD and Intel to calculate CPU power consumption.
3. Power usage effectiveness (PUE) is derived from data provided by the cloud providers and data center operators.

Static assumptions

- Memory power calculations assume a static draw value of 3 W for each 8 GB memory module.
- Network traffic power calculations rely on static power estimations for both public and private networks. These estimates are converted using the emission factor for the data center location. Static assumptions are:
 - Local network traffic uses 0.12 W per gigabyte.
 - Public network traffic uses 1.0 W per gigabyte.
- CPU calculations apply these assumptions:
 - A virtual CPU (vCPU) on any cloud host equals one thread of a physical CPU core, with two threads per core.
 - A CPU operating at 100% utilization consumes power equal to its TDP.
- Storage calculations assume that one terabyte consumes 1.2 Wh.
- Cloud storage is replicated at least twice, which doubles the energy consumption per terabyte.
- Annual country-level emission factors from the European Environmental Agency are used as input to the calculations.

Formulas

Dynatrace Cost and Carbon Optimization calculations are based on the formulas developed by the SDIA, published as a scientific paper by Tom Kennes (<https://arxiv.org/abs/2306.10049>). Dynatrace has expanded these formulas to include memory I/O, network utilization, and storage I/O using the static assumptions listed above.



Dynatrace openly shared the calculations, formulas, and code responsible for the Cost and Carbon Optimization app metrics, which the SDIA reviewed on-site.

Verification procedures

The methodology used by Dynatrace has been verified in an internal laboratory to ensure that the results are accurate. Additionally, Dynatrace has commissioned SDIA to perform an external audit to ensure that the methodology provides reliable results. While there is no continuous process of testing and verifying the calculations, we believe Dynatrace is committed to periodic internal and independent third-party verifications.

Note that calculations are stopped when data from the Dynatrace OneAgent is unavailable to avoid inaccurate estimations.

Data reported to the customer

The data reported to the customer is highly granular and includes GHG emissions and energy use for each host monitored by the Dynatrace OneAgent. The customer can export, independently process, and verify the raw measurements if needed.

Data verification by the customer

Using the static assumptions, methodology, and formulas published in the Dynatrace documentation, customers can export and recreate the reported metrics to independently verify that the calculations made by Dynatrace are accurate.

The provided documentation can also be used to perform manual spot checks by taking the resource usage of a cloud or data center infrastructure and manually calculating GHG emissions.

This meets our criteria for customers' ability to self-verify the reported data.

Observations

On-site audit

- During our audit, we identified that data reported by Google Cloud Platform (GCP) likely underestimates the GHG emissions at its facilities. One example is that for Canada, Google reports zero GHG emissions, which we have found to be inaccurate. Dynatrace has addressed this issue.
- During our audit, we found that reporting GHG emissions might not be sufficient to support direct developer or IT operations actions. We suggested introducing a wasted energy metric, which Dynatrace has since implemented.
- During our audit, we found that the Dynatrace documentation did not meet our transparency requirements, omitting the calculation methods and static assumptions. These requirements have since been met.

Independent testing

We have independently tested and verified that the Dynatrace OneAgent can be installed in Amazon AWS and Microsoft Azure environments. We have verified that OneAgent is collecting the specified utilization data and that the calculations made by the Cost and Carbon Optimization app are in line with the documented and audited formulas.

Noteworthy

We encourage adding the capability for customers to modify the app's static assumptions – including PUE and carbon intensity – for their own on-premises or cloud data centers. We believe it is important that the assumptions are both transparent and customizable. This has been implemented in the Dynatrace Cost and Carbon Optimization app. Furthermore, Dynatrace has committed to implementing even more customization abilities, allowing the configuration of almost all static assumptions.



Results

- Dynatrace has replaced GCP-derived estimations with more accurate data from Ember using country-level GHG emission factors for GCP.
- Dynatrace has implemented the wasted energy metric in their upcoming Cost and Carbon Optimization version, improving actionability for development and operations teams.
- Dynatrace has updated its documentation to include the app's underlying static assumptions.
- Dynatrace is committed to implementing more customization features for customers to modify or change the underlying assumptions.
- Based on SDIA's independent testing for AWS and Azure, we conclude that the audited formulas, calculations, and assumptions are correctly implemented and calculated.

Conclusion

SDIA concludes that the Dynatrace Cost and Carbon Optimization app is a reliable estimation system for calculating the operational GHG emissions of IT infrastructure in cloud and on-premises environments.

The calculations and methodology used are in line with the best available scientific approach, meeting relevant reporting requirements. Dynatrace meets our requirements for transparency, enabling customers to understand the calculations and to recreate the results for independent verification.

Dynatrace relies on several external sources for its assumptions; all other assumptions are publicly documented and can be customized by the customer, avoiding proprietary inputs that might negatively impact GHG emissions calculations in a non-transparent way.

Dynatrace has implemented procedures to regularly validate and update the underlying assumptions and verify that the measurements are accurate.

During the auditing process, Dynatrace worked on improvements based on our observations and implemented those improvements in the latest version of the Cost and Carbon Optimization app.

