/thoughtworks

Contact us today to learn more:
green-cloud@thoughtworks.com

Green Cloud Optimization Find out more

Handling your cloud infrastructure isn't always straightforward:

Cloud costs are through the roof... Instead, identify trends, spikes, and opportunities for cost and carbon reduction. Prioritize amongst specific optimizations and forecast savings.

Carbon impact of your cloud use is unaccounted for... Measure, monitor and report on your cloud carbon footprint as part of your Scope 3 emissions. Make it a key metric for developers and stakeholders alike in day to day and strategic decision making.

Infrastructure inhibits speed to market... You can enable faster experimentation and product delivery by reducing cloud waste. Automate green cloud approaches to reduce cycle times.

Need to meet sustainability targets... Understand your cloud carbon footprint baseline and make specific, targeted reductions to reduce your emissions, such as rightsizing, deleting idle instances, and more.

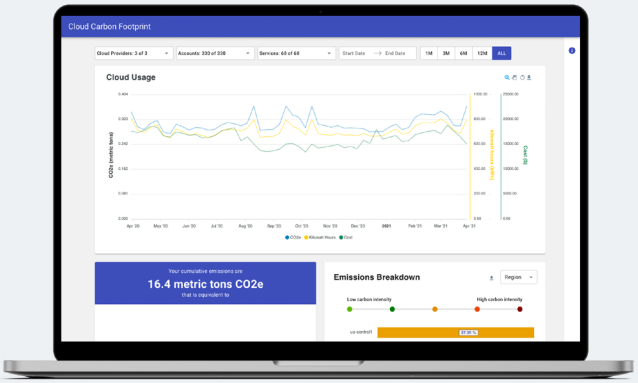
Our approach

The cost and carbon impact of your infrastructure is an opportunity

With the ability to measure and have consistent awareness and analysis, you can have trusted metrics to incoporate into your scope 3 reporting. By incorporating cloud carbon emissions into your sustainability strategy and as a cross functional requirement, you can make steady optimizations to reduce your cost and carbon footprint.

Our solution

Cloud Carbon Footprint is an open source tool that provides visibility and tooling to measure, monitor and reduce your cloud carbon emissions. We use best practice methodologies to convert cloud utilization into estimated energy usage and carbon emissions, producing metrics and carbon savings estimates that can be shared with employees, investors, and other stakeholders.



/thoughtworks

Contact us today to learn more:
green-cloud@thoughtworks.com

Solution differentiators

- **Architected to work for multiple cloud providers** including AWS, Google Cloud, and Microsoft Azure. Carbon and energy metrics are shown in one holisic view and are estimated using a singular methodology.
- **Comparison and analysis of carbon emissions** and energy at the provider, service, account, and region level, for a selected time period.
- **Provides actionable recommendations** for AWS and Google Cloud to reduce cost and carbon emissions, as well as projected savings and real world impact in trees planted.
- **Provides daily refreshed carbon estimates** enabling developers to incorporate sustainability into day-to-day decision making.
- **Monitors your energy usage and carbon footprint visually** via graphs and charts or export metrics in CSV to share with stakeholders. Shows your emissions in terms of airline flights, phonescharged and trees planeted.
- **Provides multiple ways to integrate energy and carbon metrics** in existing usage and billing data sets, data pipelines, monitoring systems or dashboard solutions.
- **The solution is open and extensible** with the potential to add other cloud providers, on-premise or co-located data centers.

How it works

Measure	**Estimates energy and carbon emissions from cloud usage.**
Audit	**Partner with the Thoughtworks Green Cloud Optimization team to audit cloud usage and strategy, and provide recommendations for reducing cost and carbon emissions.**
Improve	**Monitor metrics and recommendations over time to spot trends and take action to optimize.**
Report	**Business leaders pull data to share with employees, investors and other stakeholders.**

/thoughtworks

Contact us today to learn more:
green-cloud@thoughtworks.com

Green Cloud Optimization checklist

Configure – Make informed choices

1. **Choose a greener cloud provider:** Select a cloud provider that is more sustainably powered by renewable energy or purchases energy attributes like Renewable Energy Credits (RECs) to match the non-renewable energy used by their data centers.
2. **Make your digital supply chain more sustainable:** Ask your SaaS providers whether they are powered by renewable energy and check their website hosting using the Green Web Foundation's green web check. If not, consider self-hosting at a greener cloud provider if possible.
3. **Choose a greener cloud region and make it the default:** Select a geographic area that has a higher proportion of renewable energy in its local market and/or is closer to users. This will reduce the amount of carbon emissions produced to power that data center.
4. **Empower teams with monitoring and observability:** Ensure your teams have visibility into their cloud usage and spend via team level accounts and/or tagging, so that they are able to track and optimize over time.
5. **Baseline and track cloud energy and carbon metrics:** Use a monitoring or measurement tool to gain visibility into your cloud carbon emissions, such as the Cloud Carbon Footprint Open Source Tool and/or cloud providers' first-party carbon measurement tools.

Optimize - Improve performance and cost

1. **Optimize your compute infrastructure:** Remove idle resources and right size instances to reduce overall computation and maximize utilization. Use autoscaling to better match demand. Identify optimization opportunities using tools such as cloud provider recommendation APIs or Cloud Carbon Footprint's recommendation dashboard.
2. **Reduce storage usage:** Remove idle storage resources; improve log retention periods; optimize using life cycle configurations; use columnar data formats and compression; deduplicate your data sets; select cold storage services for long-term data; auto-archive logs/file/database tables sooner.
3. **Adopt edge computing:** Reduce network round trip times and improve performance by moving computation and storage closer to where it's needed. For example, consider Javascript Service Workers for an offline-first approach.
4. **Reduce algorithmic complexity:** Identify and refactor your most expensive lines of code with automation tools like AWS Code Guru, Codacy and other language/platform specific static analysis tools.

Continued

/thoughtworks

5. **Use AI, ML and blockchain carefully:** Optimize the size/structure of data sets because it can have a diminishing return on accuracy but a linear increase in cost. Blockchain can be overly expensive when used unnecessarily.
6. **Improve caching:** Optimize your caching strategy at multiple levels (e.g. browser/app client, CDN, application, database) to reduce network traffic and computation. For example, refresh/reload your UI at a component level.

Re-architect – More complex engineering efforts

1. **Leverage an event-driven architecture:** Because most event-driven architectures are push based, network bandwidth and computation happen on-demand, often resulting in less overall cost and carbon emissions.
2. **Containerize your applications:** Containers allow multiple workloads to run on a single operating system instance, reducing the amount of compute and storage required.
3. **Consider Serverless / FaaS:** Most major cloud providers now offer functions as a service (FaaS), eliminating the need to configure / manage your own servers and ensuring you only use the computation capacity you need.
4. **Run workloads at an optimal time:** Shift workloads to run at a time of day when there is more renewable energy in the grid or schedule services to be turned off when they aren't needed.

Frequently asked questions

Is Cloud Carbon Footprint right for me? If so, how do I get started?
Cloud Carbon Footprint is for any organization seeking to measure and/or optimize its cost and carbon emissions resulting from its cloud use. For users of Amazon Web Services, Google Cloud, and Microsoft Azure, you can get up and running quickly, within a matter of hours, by employing one of the various set-up options.

Cloud Carbon Footprint is built to be flexible and easy to use as a standalone dashboard, be integrated into your existing tooling or pipelines, or provide raw data via API or CLI.

How does Cloud Carbon Footprint work and what data do I need to provide?
Cloud Carbon Footprint currently works by querying AWS, GCP and Azure billing data to retrieve the cost, usage type, unit and amount, service name, and region from the accounts or projects you provide

Continued

it access to. It can also connect to AWS Rightsizing API, AWS Compute Optimizer API, and Google Cloud Recommender to retrieve targeted optimizations and the associated cost and energy savings. These data points are then fed into our carbon estimation logic or lookup table, and the resulting energy and carbon is surfaced either on the dashboard, via API response or the CLI, alongside the cost. Depending on the amount of data and your analysis needs, you can choose to view by day, week, month or quarter for the time period you specify.

Cloud Carbon Footprint can estimate and provide a csv output of **on-premise emissions** using the same methodology, given the necessary input data is provided. If you have usage from a different cloud provider or colocation data center, Cloud Carbon Footprint can be customized to meet these needs, given there is access to the necessary usage information.

How is carbon measured? Does it take into account my offsets or those purchased by the cloud providers?

Cloud Carbon Footprint pulls your usage data from each public cloud provider, and converts that into energy based on the type of usage and the underlying architecture. Then using **publicly available coefficients** and grid intensity factors, it calculates the carbon produced or possibly saved. Your carbon estimates and savings are updated as often as the cloud provider data is updated, which is at least daily or hourly.

When measuring emissions resulting from energy use to include in your Scope 3 reporting, there are two approaches: location based and market based. While market based measurement takes into account energy attributes purchased by cloud providers such as renewable energy credits or power purchase agreements, it does not depict the actual emissions being produced in the first place when you use electricity. To provide a truer measure of the emissions impact from your cloud use, Cloud Carbon Footprint uses location based reporting and calculates the CO2e using the respective grid intensity of the data centers where you have usage. This approach better incentivizes teams to measure and reduce their cloud carbon emissions. It is worth noting that the tool currently does support a configuration to take into account Google's Carbon Free Energy Percentage for Google Cloud Estimates.

How is Cloud Carbon Footprint different from the carbon measurement tools cloud providers are already offering their customers?

Cloud Carbon Footprint is first and foremost a free and open source tool, accessible and extensible to meet your needs or fit within your existing tooling. Cloud Carbon Footprint's code and methodology are open and transparent, and are constantly improving based on insights and reviews from experts in the open source and sustainability community.

One such example is the inclusion of embodied emissions for a fuller picture of overall emissions.

Continued

/thoughtworks

Have another question?
green-cloud@thoughtworks.com

With multi-cloud support, it applies the same methodology across multiple cloud providers so that all of your usage can be viewed and compared in one place, enabling you to develop an informed cloud computing strategy. Estimates are updated as frequently as your billing data, creating short feedback loops and allowing this data to be considered in day to day development work. Cloud Carbon Footprint also focuses on enabling and encouraging cost and carbon savings, with its real world comparison, forecasting component and targeted recommendations for optimizations.

How does Cloud Carbon Footprint help me make carbon reductions?

Cloud Carbon Footprint lets you see all of your cloud usage and related carbon emissions in one place, and through the filtering options and various breakdowns, begin to identify areas to target for greatest optimization of costs and emissions reductions.

In addition to analysis, it also has a recommendations dashboard with the forecasted savings, real-world equivalency, and table of specific targeted optimizations such as changing instance size or stopping idle resources. We find that the best strategy for reductions is by making many small optimizations, which add up to a large impact together. Cloud Carbon Footprint's monitoring capabilities and recommendations enable you to treat carbon as a cross functional requirement during development, like you would security, performance or accessibility. Beyond the rightsizing and idle resource recommendations provided in the dashboard, the Green Cloud Optimization checklist outlines additional strategies to optimize, reduce cloud carbon emissions and design sustainable infrastructure.

How is Thoughtworks involved in the use of the tool?

Measuring and reducing your cost and carbon emissions by leveraging the capabilities of the Cloud Carbon Footprint tool is an important start to your green cloud journey. As a thought leader in the digital sustainability space, Thoughtworks sought to provide visibility into the relationships between carbon and technology and methods to assist in setting and meeting SBTI targets, through the creation the Cloud Carbon Footprint tool with its measurement and monitoring features, and by helping to found the Green Software Foundation which recently published the Software Carbon Intensity Specification. With these qualifications and continuing experience helping our clients meet sustainability goals, Thoughtworks can help you both start your journey baselining your emissions with Cloud Carbon Footprint, and address your unique challenges by customizing the tool. With a history of expertise in cloud migrations, optimizations and enterprise modernization, we work with our clients to identify larger opportunities for cost and carbon reduction in their infrastructure, create and prioritize a roadmap to meet their goals, and implement those changes.

Continue your Green Cloud journey

Find out more about Cloud Carbon Footprint
Learn more about the Thoughtworks Green Cloud approach