**Carbon Aware SDK**

Green software is software designed and implemented to have the lowest possible carbon emissions.

The Carbon Aware SDK is a project as part of the Green Software Foundation (GSF) and the GSF Open Source Working Group.

Appointments

Chair/Project lead - Vaughan Knight (Microsoft)

Vice Chair - Szymon Duchniewicz (Avanade)

You can reduce the carbon footprint of your application by just running things at **different times** and in **different locations**. That is because not all electricity is produced in the same way. Most is produced through burning fossil fuels, some is produced using cleaner sources like wind and solar.

The Carbon Aware SDK helps you build the carbon aware software solutions with the intelligence to use the greenest energy sources. Run them at the greenest time, or in the greenest locations, or both! Build software that chooses to run when the wind is blowing, enable systems to follow the sun, moving around the world to where energy is the greenest, and create tools that give insights and help software innovators to make greener software decisions. ***All of this helps reduce carbon emissions.***

A foundational principle of Green Software is known as carbon-aware computing, which involves shifting compute to times and places where the carbon intensity of the grid results in lower carbon emissions.

What is the Carbon Aware SDK?

At its core the Carbon Aware SDK is a WebApi and Command Line Interface (CLI) to assist in building carbon aware software.

What does the SDK/API provide that 3rd party data providers such as WattTime or ElectricityMaps do not?

Many of the benefits tend to relate to removing the tight coupling of an application from the 3rd party data source it is using. This abstraction allows for changing of data providers, data provider aggregation, centralised management, auditability and traceability, and more.

The Carbon Aware SDK will take care of all conversions to a standardised gCO2/kWh, which becomes increasingly valuable with aggregated data sources.

Getting Started Overview

There are several ways to consume CarbonAware data for your use case. Each approach surfaces the same data for the same call (e.g. the CLI should not give you different data than the WebAPI for the same query).

Carbon Aware WebApi

This is best when you can change the code, and deploy separately. This also allows you to manage the Carbon Aware logic independently of the system using it.

**Endpoints**

*GET emissions/bylocation*

This endpoint calculates the observed emission data by location for a specified time period.

*GET emissions/bylocations*

This endpoint calculates the observed emission data by an array of locations for a specified time period

*GET emissions/bylocations/best*

This endpoint calculates the best observed emission data by an array of locations for a specified time period

*GET emissions/forecasts/current*

This endpoint fetches only the most recently generated forecast for all provided locations.

The scoped data points are used to calculate average marginal carbon intensities of the specified "windowSize" and using which the optimal marginal carbon intensity window is identified.

The forecast data represents what the data source **predicts** future marginal carbon intensity values to be, not actual measured emissions data.

*POST emissions/forecasts/batch*

This endpoint takes a batch of requests for historical forecast data, fetches them, and calculates the optimal marginal carbon intensity windows for each using the same parameters available to the '/emissions/forecasts/current' endpoint.

This endpoint is useful for back-testing what one might have done in the past, if they had access to the current forecast at the time.

*GET emissions/average-carbon-intensity*

This endpoint retrieves the measured carbon intensity data between the time boundaries and calculates the average carbon intensity during that period.

*POST emissions/average-carbon-intensity/batch*

This endpoint takes an array of request objects, each with their own location and time boundaries, and calculates the average carbon intensity for that location and time period.

This endpoint only supports batching across a single location with different time boundaries.

*GET /locations*

This endpoint lists all the supported locations that the datasources potentially can have access to. This information is coming from the location-source/json files that contain dictionaries in the form of <A Location key name, GeoCoordinates>

**Data Sources**

WattTime

WattTime Locations

Each WattTime emissions data point is associated with a particular named balancing authority. For transparency, this value is also used in EmissionsData response objects. It is not overwritten to match the named datacenter provided by any request.

WattTime technology—based on real-time grid data, cutting-edge algorithms, and machine learning—provides first-of-its-kind insight into your local electricity grid’s marginal emissions rate.

The WattTime API provides access to real-time, forecast, and historical marginal emissions data for electric grids around the world. The marginal emissions rate we provide is a Marginal Operating Emissions Rate (MOER), in units of pounds of emissions per megawatt-hour (e.g. CO2 lbs/MWh).

They are using an Empirical Model for calculating the marginal emissions rates. It is regression-based data modelling. It is all data-driven with no assumptions.

Links referred:

<https://news.microsoft.com/de-ch/2023/01/10/carbon-aware-computing-whitepaper/>

<https://github.com/Green-Software-Foundation/carbon-aware-sdk/blob/dev/docs/carbon-aware-webapi.md>

<https://marketplace.visualstudio.com/items?itemName=ms-vscode-remote.remote-containers>

<https://github.com/Green-Software-Foundation/carbon-aware-sdk>

<https://github.com/Green-Software-Foundation/carbon-aware-sdk/blob/dev/docs/selecting-a-data-source.md>

<https://github.com/Green-Software-Foundation/carbon-aware-sdk/blob/dev/docs/overview.md>

<https://static.electricitymaps.com/api/docs/index.html#introduction>

<https://www.watttime.org/api-documentation/#introduction>

<https://www.watttime.org/about/>