Lufthansa Industry Solutions

Determine software emissions

Munich | April 26, 2024

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01 Person & LHIND

Person

Moritz Bölter

IT consultant
greening of IT

Training

- Dual studies in Applied Computer Science at Nordakademie Elmshorn 2014–2018
- Master studies in Practical Computer Science at Fern-universität Hagen 2022–2024

Experiences

- Greening of IT projects
- Release integration & DevOps
- Backend developer
- Technical consultant for an ERP system

Emphases

- Greening of IT topics and projects
- Backend development with Java and GoLang

We tell you how it is. Numbers, data and facts about the company.

1995 Inception as a division within Lufthansa Systems AG

100% **equity interest** Lufthansa Group

315 **million EUR revenue in 2023***

*(over 40% of which is outside the LH Group)

14 **locations** Headquarters in Norderstedt near Hamburg

Further branches in Germany, Albania, Switzerland and the U.S.A.

2,500 employees (Q4, 2023)

300 **clients**

Top ranking: **best IT service providers 2023***

*Source: brandeins | for the fourth time in a row

One of the **25** largest IT consultancies in Germany*

*Source: Lünendonk-Liste 2022 | for ten years

Aviation: **3%**

IKT: **4%**

Software life cycle assessment

Problem

- Unknown carbon footprint of software
- Relevance to clarify in order to comply with new regulations
- Need for transparency

Solution

- Measurements to determine the CO_2 footprint of software
- Inclusion of all relevant phases of a software life cycle
- Inclusion of production of hardware for development and operation
- Defined scope of consideration

Result

- Overview of total carbon footprint of software
- Knowledge of the distribution of emissions for different phases and hardware
- Potentials for emission reductions identified

02 Software under test

About the software under test

- Backend service
- Connected to different other backend services via REST APIs
- Collects and unifies data from external partners and provides the information
- Global service with 24/7 usage
- Constant load of about 2–3 requests per second
- Running on Kubernetes cluster in Google Cloud
- Developed since end of year 2020

03 Measurement & data collection process

Stages of a software life cycle assessment

Development

Provisioning

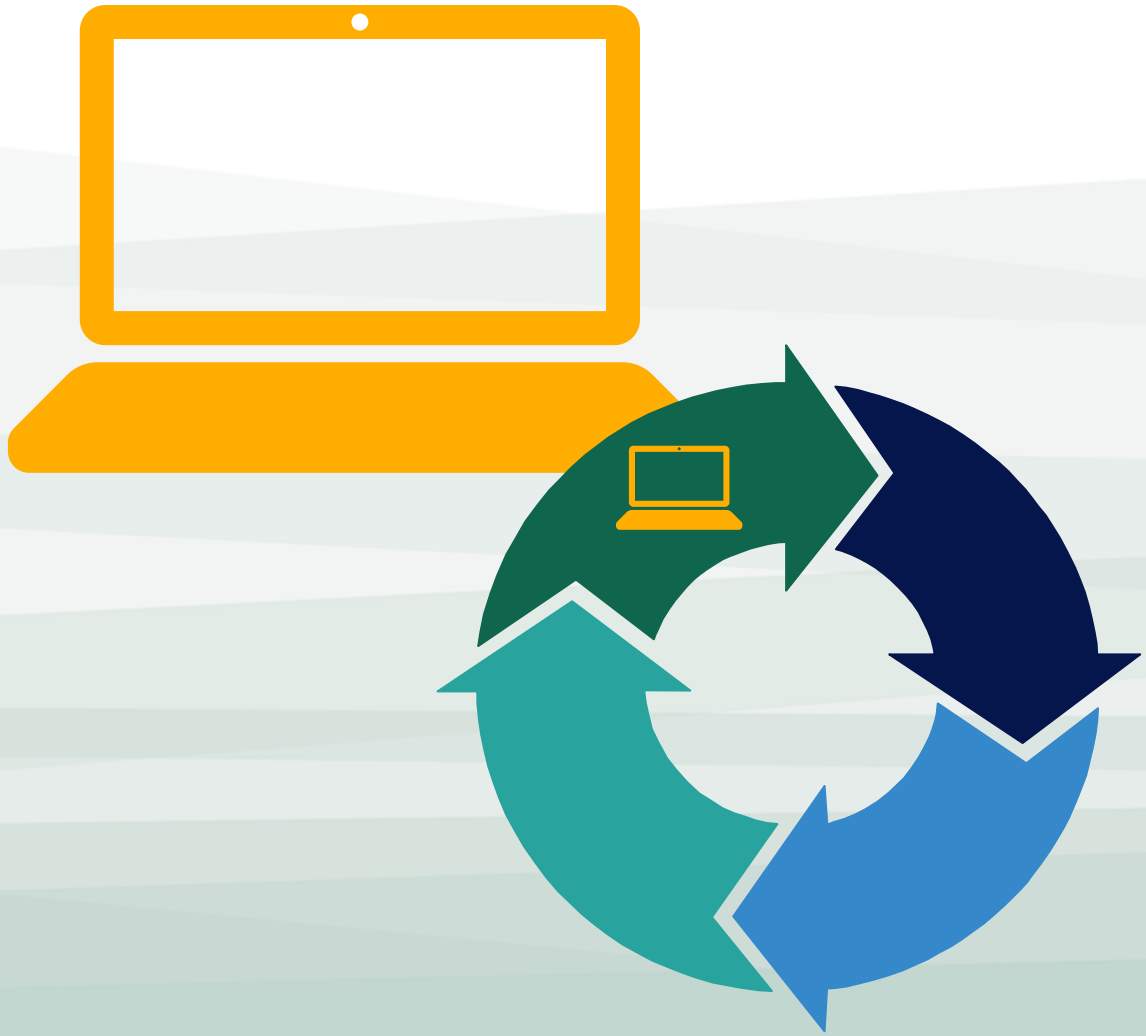
Removal

Usage

Stages of a software life cycle assessment

Development

- Power consumption due to development
- Carbon footprint of hardware used for development (production, transportation, recycling)
- Problem of library measurement
  ➡ how does one allocate emissions to software products?



Stages of a software life cycle assessment

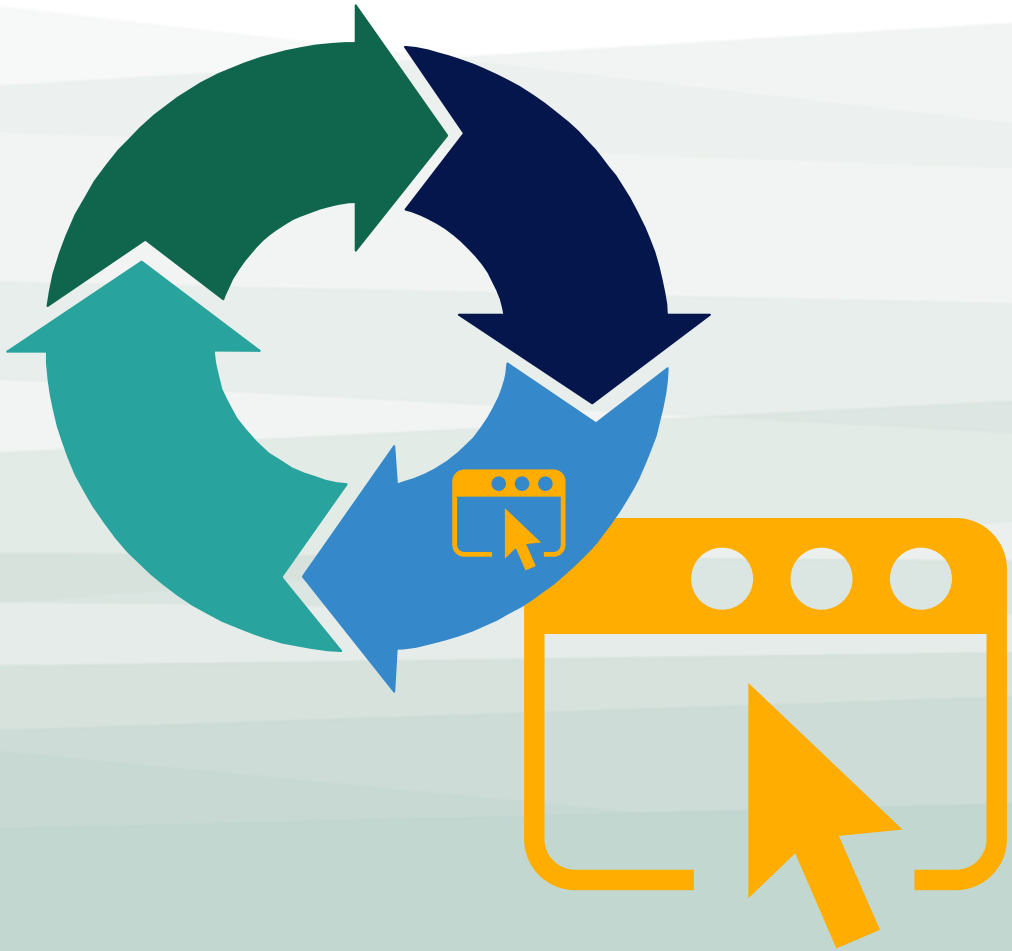
Provisioning

- Effect on total emissions depends on frequency of releases
- Power consumption during installation of software
- Boot phase of the software
- Relatively small effect on overall emissions due to virtualization

Stages of a software life cycle assessment

Usage

- Measure power consumption for the operation of servers executing the software
- Consideration of all relevant environments
- Carbon footprint of hardware of servers (production, transport, recycling)
- Network traffic emissions from server to client
- Depending on scope, investigation of emissions of client hardware necessary



Stages of a software life cycle assessment

Removal

- Measure power consumption for shutting down and removing containers
- Easy measurement in containerized environments
- Small factor in comparison to total emissions

The technical setup for measurement

- Separated bare metal server
  - Dell Rack server
  - 8 physical CPU cores, 32 logical cores
  - Intel(R) Xeon(R) CPU E5-2640 v3 @ 2.60GHz
  - 126 Gibibyte RAM
- Only used for measurement
- Linux Ubuntu
- Docker rootless mode
- Green Metrics Tool
- Software under test

Green Metrics Tool as measurement tool

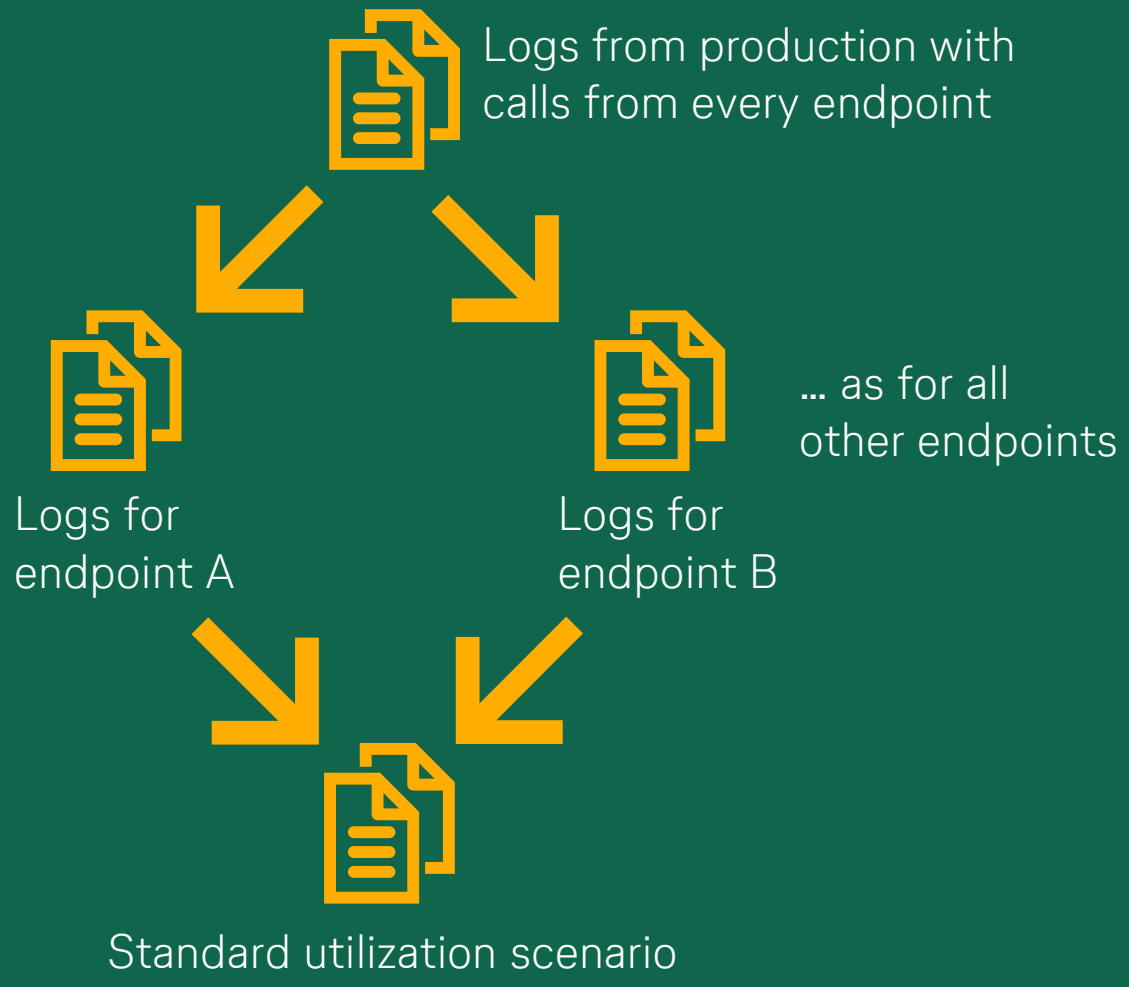
- Open-source project by Green Coding Solutions GmbH
- Measurements for all life cycle stages
- Different metrics providers can be plugged in:
  - IPMI
  - Intel RAPL
  - Machine learning models
- Requires container-based applications
- Uses the provided standard utilization scenario

Standard utilization scenario

1. Analysis of usage in production system
- Collect/analyze accesslog messages
- Ideally for longterm compensation for fluctuations

2. Categorize and obtain ratio between used endpoints depending on functional unit in order to recreate a realistic test scenario

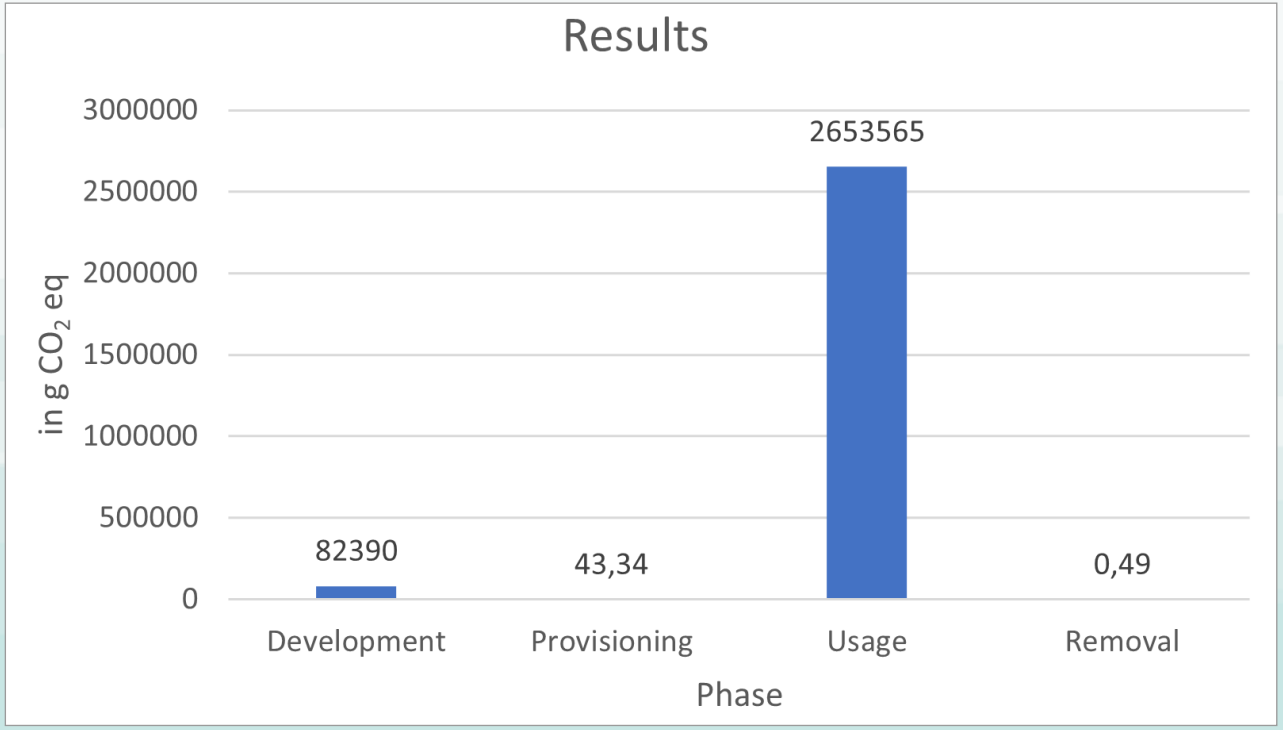
3. Implement standard utilization scenario based on analyzed data



04 Results & learnings

Results

- 2,7 t CO_2eq total emissions in three years
- 0,01 g per request
- Most relevant topic is the hardware energy consumption during usage phase
- Critical review approved by external review partner



Outlook

- We are improving our process to measure software emissions continuously
  - Automation of collecting data
  - More areas of application
- Different methodologies of greenhouse gas determinations used from different data sources

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Let’s stay in **CONTACT**:

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THANK you for joining my presentation

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