

# GreenMetaData: Standardising Environmental Impact Reporting for Computational Research

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Dr Caterina Doglioni, Dr Christina Bremer, Dr Dylan Powell, Jyoti Bhogal, Dr Loïc Lannelongue,  
Michael Sparks, Dr William Haese-Hill

# Meet Your Speaker

## Jyoti Bhogal

- Co-founder & Co-lead, RSE Asia Association
- SSI Fellow 2025
- CEF by CSCCE Graduate
- Open-source contributor
- Community Manager, Research Software Alliance
- Software Quality Assurance Engineer | Clinical Trial Design Optimization
- M.Sc. (Statistics)



Co-Founder & Co-Lead



SSI Fellow 2025



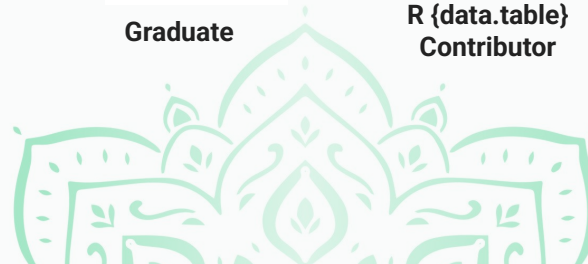
Research Software Engineering Contributor



Graduate



R {data.table} Contributor



# What is Green/Sustainable Computing?

According to the Brundtland Commission (1987) sustainability is defined as *“meeting the needs of the present without compromising the ability of future generations to meet their own needs.”*

# GreenMetaData - What is it?

A **tool** to create a standardised green **metadata file format**.

# GreenMetaData - Why do we need it?

- Growing need for standardised ways to report the environmental impacts of computational research projects
- Funders are starting to request it
- Researchers are voluntarily doing it to acknowledge the impact of their work,
- Journals struggle to request it in the absence of guidelines.

# GreenMetaData - What does it give you?

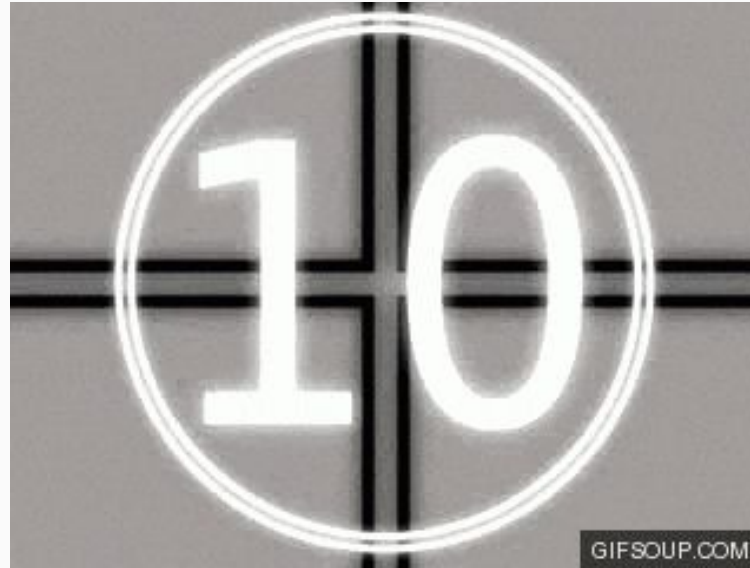
- It gives is a **human and machine-readable metadata file format** as a **YML** file.
- This file be used to **report the carbon footprint and other sustainability metrics** of computational research projects with full transparency on the methodology used.

# GreenMetaData - Where to use the output?

This output YML file can be used:

- while you create your project reports,
- for creating journal articles, grant applications, etc.
- to add a metadata file to your software repository, like GitHub

# Demo Time!



# Demo: Landing Page



## MetaGreenData

Generate standardized environmental impact metadata for your research



### Travel

Document the environmental impact of research-related travel.

[Get Started](#)



### Experimental Work

Track the environmental footprint of laboratory experiments.

[Get Started](#)



### Computing

Measure the environmental impact of computational research.

[Get Started](#)

Choose a category to begin generating your environmental impact metadata

# Demo: Computing Tab



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# Demo: Three Panes - Progress bar, Impact computing form, Live YML output preview

The screenshot shows a web browser at the URL 127.0.0.1:8000/computing/. The interface is divided into three main panes:

- Progress:** A vertical sidebar on the left with a green progress bar at the top. It contains four menu items: 'Basic Information' (selected), 'Embodied Impact', 'Operational Impact', and 'Preview & Download'.
- Computing Impact Form:** The central area contains a form with a '← Back' button. The form is titled 'Basic Information' and includes:
  - Project Title:
  - Repository URL:
  - Project Description:
  - Keywords (comma-separated):
  - A note: 'Separate keywords with commas'
  - A 'Next: Embodied Impact' button.
- Live Preview:** A dark panel on the right showing the generated YML output for the 'Computing' section:

```
Computing:  
  Embodied:  
    Carbon footprint: {}  
    Depletion of Abiotic Resources  
(Minerals, Metals): {}  
    Particulate Matter Emissions: {}  
    Acidification potential: {}  
    Ionising Radiation Related to Human  
Health: {}  
    Photochemical Ozone Formation: {}  
    Abiotic Depletion Potential (Fossil  
Fuels): {}  
    Freshwater Eco-Toxicity Potential: {}  
  Operational:  
    Impact values: {}  
  Methods and scope:  
    Software boundaries: {}  
    Tool stages: {}  
    Hardware boundaries: {}  
  Infrastructure:  
    Power Usage Effectiveness (PUE): {}  
    Water usage effectiveness: {}  
    Electricity carbon intensity: {}
```

# Demo: Embodied Impact

127.0.0.1:8000/computing/

## Progress

- Basic Information
- Embodied Impact**
- Operational Impact
- Preview & Download

## ← Back Computing Impact Form

### Embodied Impact

#### Carbon Footprint

Carbon footprint (gCO<sub>2</sub>e):

Source and method (carbon footprint):

#### Depletion of Abiotic Resources (Minerals, Metals)

Depletion of Abiotic Resources (kg Sb-eq):

Source and method (depletion):

#### Particulate Matter Emissions

Particulate Matter Emissions (disease incidence):

Source and method (particulate matter):

### Live Preview

```
Computing:
Embodied:
  Carbon footprint: {}
  Depletion of Abiotic Resources
  (Minerals, Metals): {}
  Particulate Matter Emissions: {}
  Acidification potential: {}
  Ionising Radiation Related to Human
  Health: {}
  Photochemical Ozone Formation: {}
  Abiotic Depletion Potential (Fossil
  Fuels): {}
  Freshwater Eco-Toxicity Potential: {}
Operational:
Impact values: {}
Methods and scope:
  Software boundaries: {}
  Tool stages: {}
  Hardware boundaries: {}
Infrastructure:
  Power Usage Effectiveness (PUE): {}
  Water usage effectiveness: {}
  Electricity carbon intensity: {}
```

# Demo: Operational Impact

The screenshot shows a web browser at the URL `127.0.0.1:8000/computing/`. The page is titled "Computing Impact Form" and has a "Back" button. On the left, a "Progress" sidebar shows four steps: "Basic Information", "Embodied Impact", "Operational Impact" (which is active and highlighted with a lightning bolt icon), and "Preview & Download".

The main content area is titled "Operational Impact" and contains two sections:

- Impact Values:** A table with three input fields:
  - Energy consumption (in kWh): Enter a number
  - Carbon footprint (in gCO2e): Enter a number
  - Water consumption (in liters): Enter a number
- Methods and Scope:** Two columns of checkboxes:
  - Software boundaries - Stages included:** Development and testing, Deployment, Use, Maintenance.
  - Hardware boundaries - Components included:** CPUs, GPUs, Memory, Storage, Networking.
  - Tool stages included:** Development and testing, Deployment, Use.

A "Live Preview" overlay on the right shows a JSON-like representation of the form's data:

```
Computing:
  Embodied:
    Carbon footprint: {}
    Depletion of Abiotic Resources
(Minerals, Metals): {}
    Particulate Matter Emissions: {}
    Acidification potential: {}
    Ionising Radiation Related to Human
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    Freshwater Eco-Toxicity Potential: {}
  Operational:
    Impact values: {}
  Methods and scope:
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    Hardware boundaries: {}
  Infrastructure:
    Power Usage Effectiveness (PUE): {}
    Water usage effectiveness: {}
    Electricity carbon intensity: {}
```

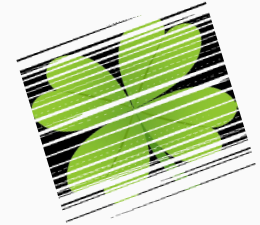
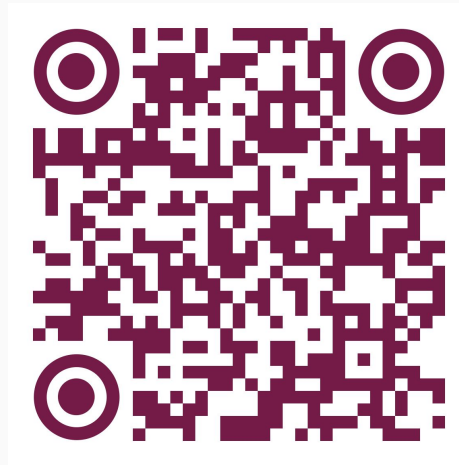
# Demo: Preview and download YML - Human and Machine readable

The screenshot shows a web browser at the URL 127.0.0.1:8000/computing/. The page title is 'Computing Impact Form'. On the left, a 'Progress' sidebar lists four steps: 'Basic Information', 'Embodied Impact', 'Operational Impact', and 'Preview & Download' (which is currently selected). The main content area has a 'Back' button and a 'Preview & Download' section containing 'Previous' and 'Download YML' buttons. A dark overlay on the right displays the 'Live Preview' of the YML data, which is a JSON object with the following structure:

```
Computing:
  Embodied:
    Carbon footprint: {}
    Depletion of Abiotic Resources
  (Minerals, Metals): {}
    Particulate Matter Emissions: {}
    Acidification potential: {}
    Ionising Radiation Related to Human
  Health: {}
    Photochemical Ozone Formation: {}
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    Freshwater Eco-Toxicity Potential: {}
  Operational:
    Impact values: {}
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    Power Usage Effectiveness (PUE): {}
    Water usage effectiveness: {}
    Electricity carbon intensity: {}
```

# GitHub - Where the code is located

Scan me to see the source code or to use me in your projects!



GitHub link: <https://github.com/GreenAlgorithms/GreenMetaData>

# Key takeaways

- Working on the environmental impact of one's computing projects starts with **measuring** and **quantify** the **impact**
- There are multiple **Calculators** to do this: **GreenAlgorithms**, **Carbon Tracker**, etc.
- Once you calculate these, you could **store in a YML metadata file format**, which is **human** as well as **machine readable**
- **How to use this YML file?** For outreach of your projects, you can
  - store this file in your GitHub repository,
  - attach it with your project documentation,
  - share the metadata while writing a grant proposal

# Thank you!



Image source: The Turing Way Book

