UrbanTwin: Digital Twins at the Service of a Sustainable Future through Integrated Urban Systems

Catarina Braz+, Denisa Constantinescu*, Rubén Rodríguez Álvarez*, Alejandro Romo*, Gaëtan Jenni*, François Maréchal+, David Atienza *

* ESL-EPFL, + IPESE-EPFL

Motivation

Urban areas are highly interrelated with climate change. They are responsible for 75% of GHG emissions, while their livability is significantly impacted by climate change.

UrbanTwin Aims

Develop and validate an integrated tool to support decision-makers in achieving environmental targets at the urban scale, such as the Swiss Energy Strategy 2050 and the vision of climate-adaptive "sponge cities".

Key Results

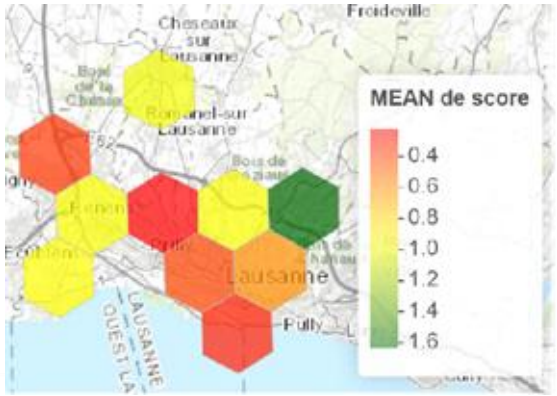
UrbanTwin tool (platform + database)

Modelling future renewable energy integration infrastructure in the city of Lausanne.

© EPFL, ETHZ, WSL, SIL (WP1, WP4)

Technology adoption trends

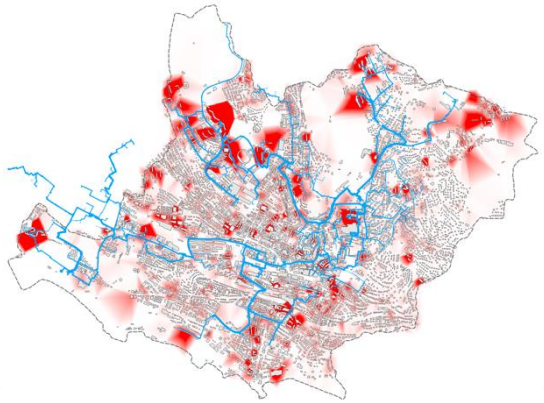
Impact of low-carbon policies and behaviours on technology penetration. Application to the city of Lausanne.



© EPFL, EAWAG (WP2)

Waste energy recovery

Exploration of the energy potential of domestic hot wastewater in the city of Lausanne.



© EPFL, IPESE (WP1)

Contacts: catarina.braz@epfl.ch, françois.marechal@epfl.ch

Scaling up CATS, The *Climate-Aware Task Scheduler*, for cluster computing and international reach

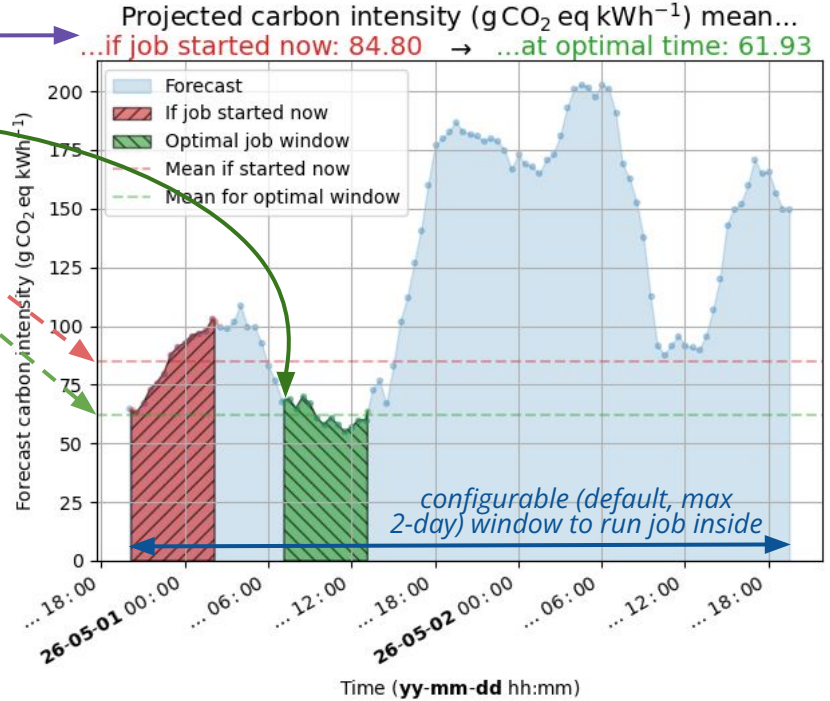
Sadie L. Bartholomew (presenting, sadie.bartholomew@ncas.ac.uk), Lincoln Colling, Abhishek Dasgupta, Anthony J. Greenberg, Loïc Lannelongue, Colin Sauzé, Andrew M. Walker

CATS is a Python library and command-line **tool that calculates the optimal time to run a compute job to minimise its carbon intensity**. Version 1 targets local jobs while the upcoming Version 2 will support use on clusters through integration with batch scheduling systems (Slurm at first). It is not the only carbon-aware scheduling tool, but offers a lightweight general solution designed to be user friendly that could e.g. serve educational purpose:

expected job runtime *job location as a UK* postcode* *optional plot of intensity series*

```
$ cats --duration 360 --location "SW1A" --plot

Best job start time                 = 2026-05-01 08:09:11
Carbon intensity if job started now = 84.80 gCO2eq/kWh
Carbon intensity at optimal time    = 61.93 gCO2eq/kWh
```



CATS can optionally schedule the job to run at the optimal time via extra arguments `--scheduler` and `--command`, with 'at' and 'sbatch' supported in v1, e.g:

```
<command above> --scheduler at --command 'python work.py'
```

With Slurm support for cluster use in v2, we aim to develop a 'green' queue incorporating CATS into volunteer HPC systems.

Help us find APIs!

*CATS is constrained by availability of APIs for electricity grid forecasts so at present only works in the UK.

Please let us know using the QR code if you know of any suitable APIs for other countries or areas!

Install: `pip install climate-aware-task-scheduler`

Paper (to cite): see QR code, Bartholomew et al. (2025), *Journal of Open Source Software*

Codebase: <github.com/GreenScheduler/cats>

Docs: <cats.readthedocs.io>

GreenMetaData: Standardising Environmental Impact Reporting for Computational Research

Sustainability Conference for Responsible Research Computing (SC4RC) 2026, CERN, Geneva

4-8 May 2026

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

1. What?

A standardised green metadata file format.

2. Why?

Growing need for standardised ways to report the environmental impacts of computational research projects

3. How?

- Find out environmental impact using calculators.

- Use this tool ‘GreenMetaData’ to create a standard metadata file format.

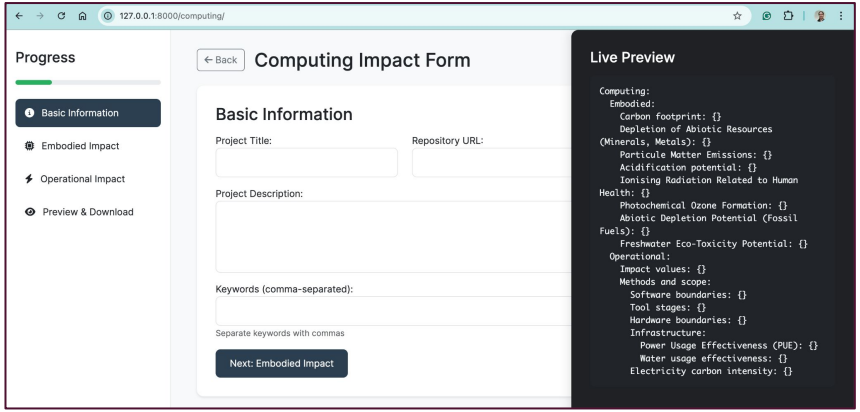
Scan me to see or use the code!

4. Output usage:

- while you create your project reports

- for creating journal articles, grant applications, etc.

- to add a metadata file to your software repository, like GitHub



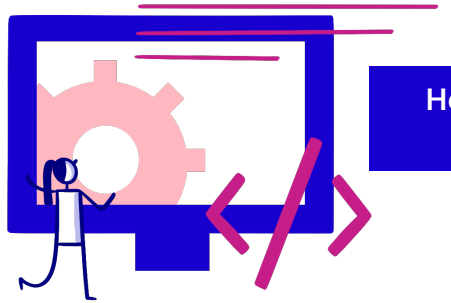
Sustainability Conference for SC4RC Responsible Research Computing

GitHub link:

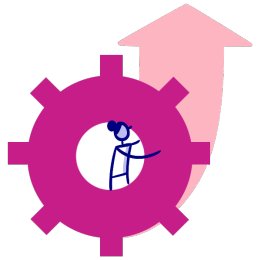
https://github.com/GreenAlgorithms/GreenMetaData

Poster: Developing a Sustainable Institutional Research Computing Culture

We're seeing an explosion in demand for resources and the associated **increase in energy and water use, and the embodied carbon associated with the infrastructure we use**.



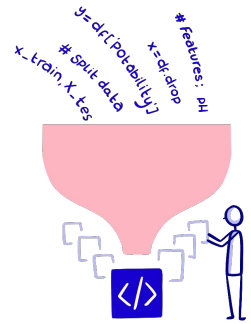
How efficient is your code?



The **three pillars** of a sustainable institutional research computing culture

Efficient use and management of digital infrastructure is vital to ensure sustainability aims can be met.

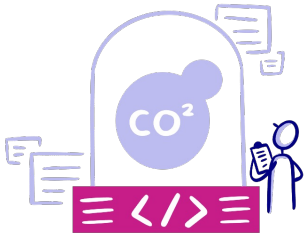
How much energy is your use of LLMs for software development consuming?



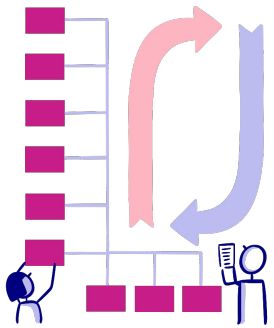
Community

Education

Advocacy



Providing straightforward, actionable guidance applicable to all members of our institutional community through central IT's "**7 steps to ICT sustainability**" initiative



Are you efficiently managing your data?

IMPERIAL

SC4RC26: Sustainability Conference for Responsible Research Computing
Wednesday 6th May 2026, Geneva, Switzerland