Green Software Engineering

Building energy measurement tools and ecosystems around software

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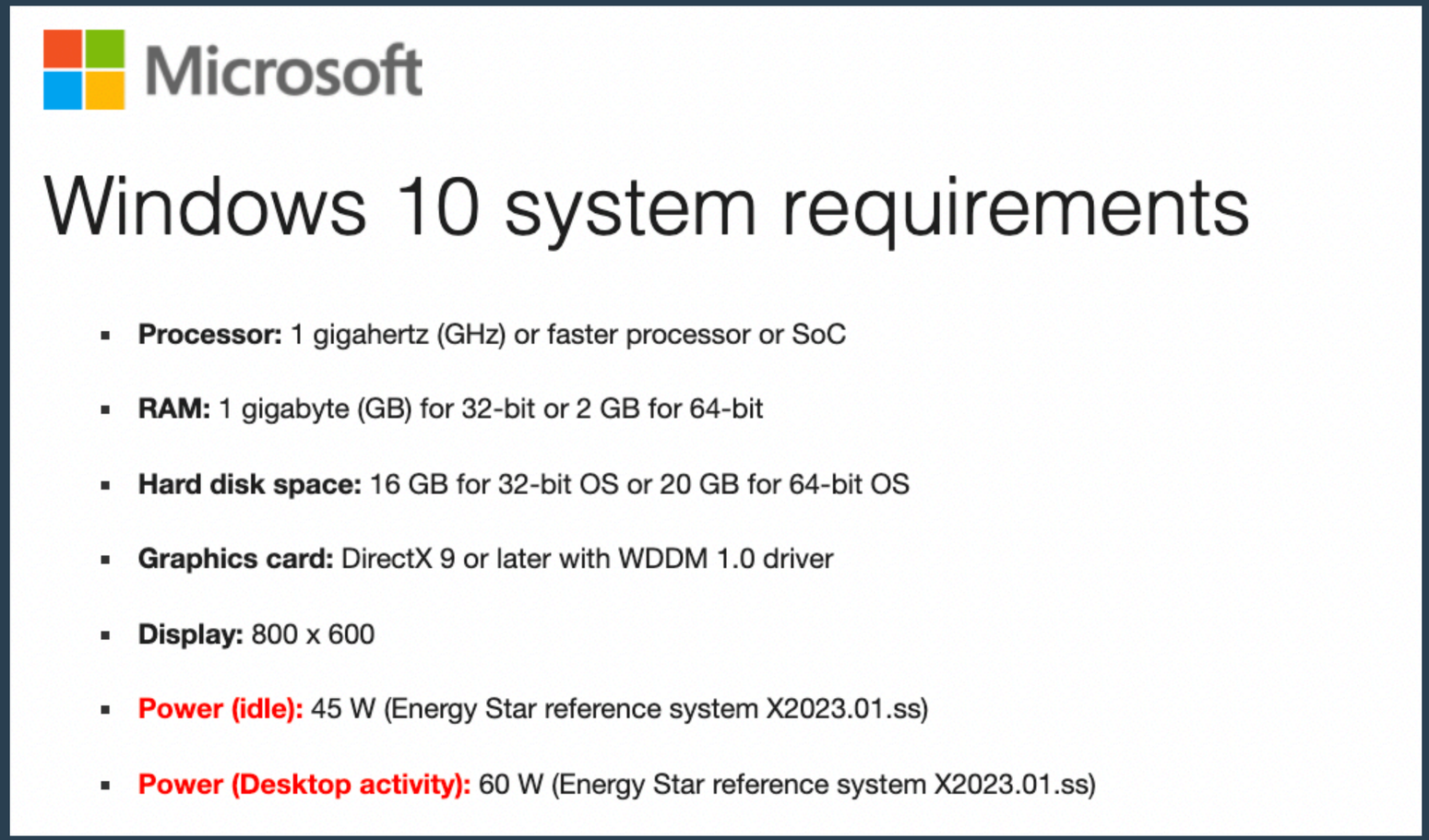
Imagine ...

A world where energy is a first order metric ...



No actual footage! Concept picture!

Imagine ...

And you could make informed choices about energy

Microsoft

Windows 10 system requirements

- **Processor:** 1 gigahertz (GHz) or faster processor or SoC
- **RAM:** 1 gigabyte (GB) for 32-bit or 2 GB for 64-bit
- **Hard disk space:** 16 GB for 32-bit OS or 20 GB for 64-bit OS
- **Graphics card:** DirectX 9 or later with WDDM 1.0 driver
- **Display:** 800 x 600
- **Power (idle):** 45 W (Energy Star reference system X2023.01.ss)
- **Power (Desktop activity):** 60 W (Energy Star reference system X2023.01.ss)

No actual footage! Concept picture!

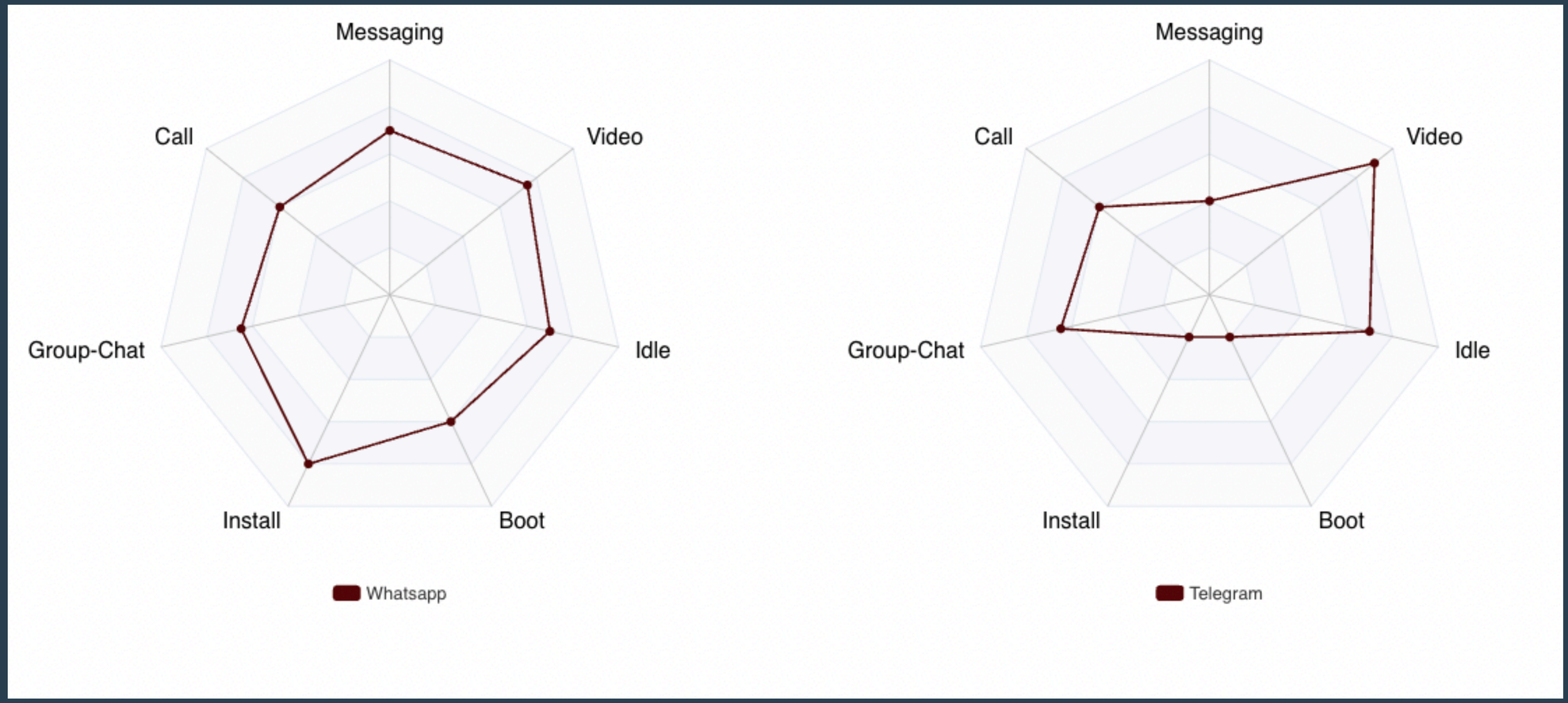
Ubuntu Desktop Edition

1. 2 GHz dual core processor
2. 4 GiB RAM (system memory)
3. 25 GB (8.6 GB for minimal) of hard-drive space (or USB stick, memory card or external
4. VGA capable of 1024x768 screen resolution
5. Either a CD/DVD drive or a USB port for the installer media
6. Internet access is helpful
7. Power (idle): 20 W (Energy Star reference System X2023.01.ss)
8. Power (Desktop activity): 35 W (Energy Star reference System X2023.01.ss)

Imagine ...

You could compare software energy consumption easily ...

No actual data! Concept picture!



Energy consumption of Whatsapp vs. Telegram - per usage scenario

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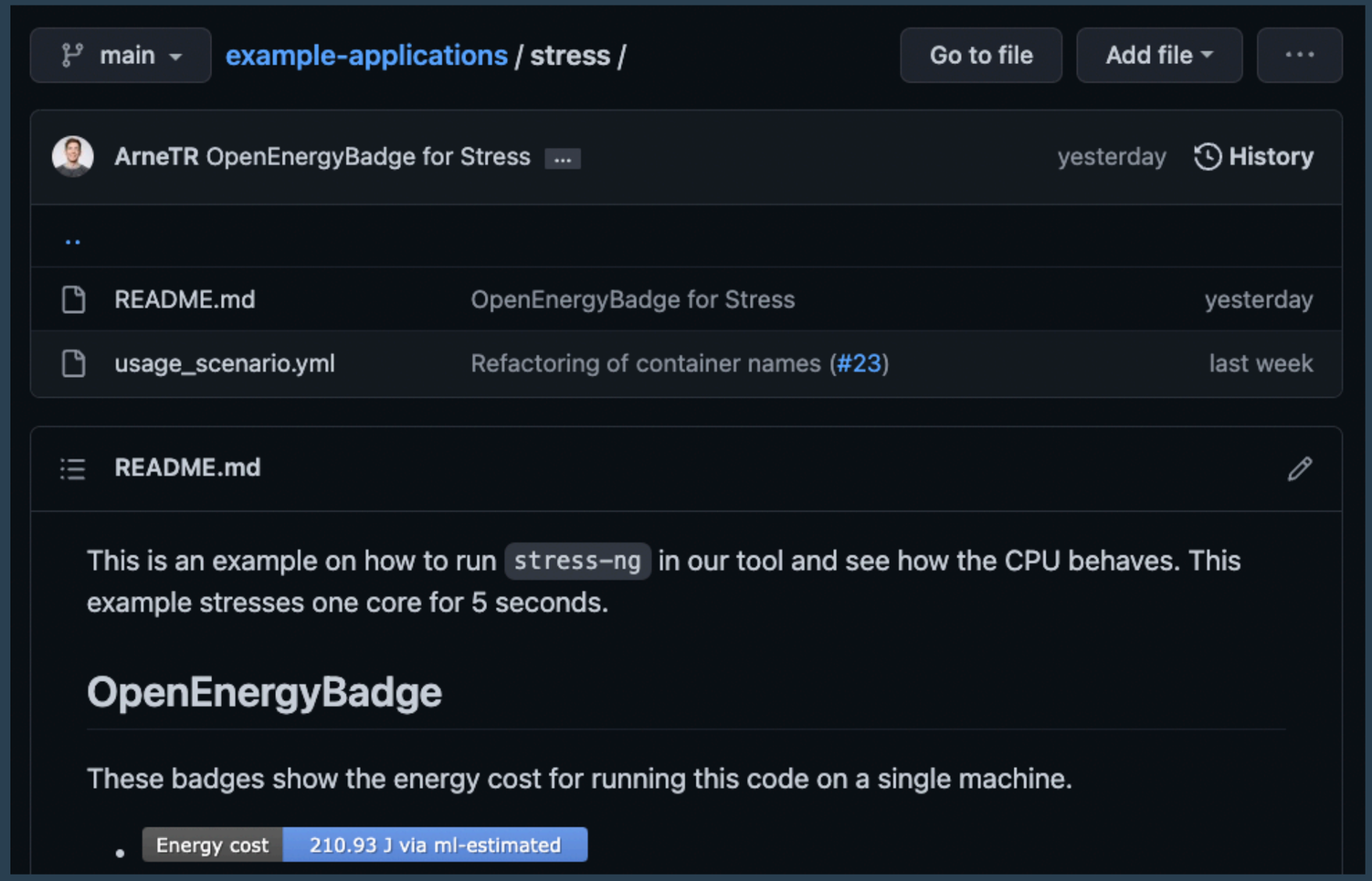
Imagine (as a developer :))....

Every repository would have an energy badge ...

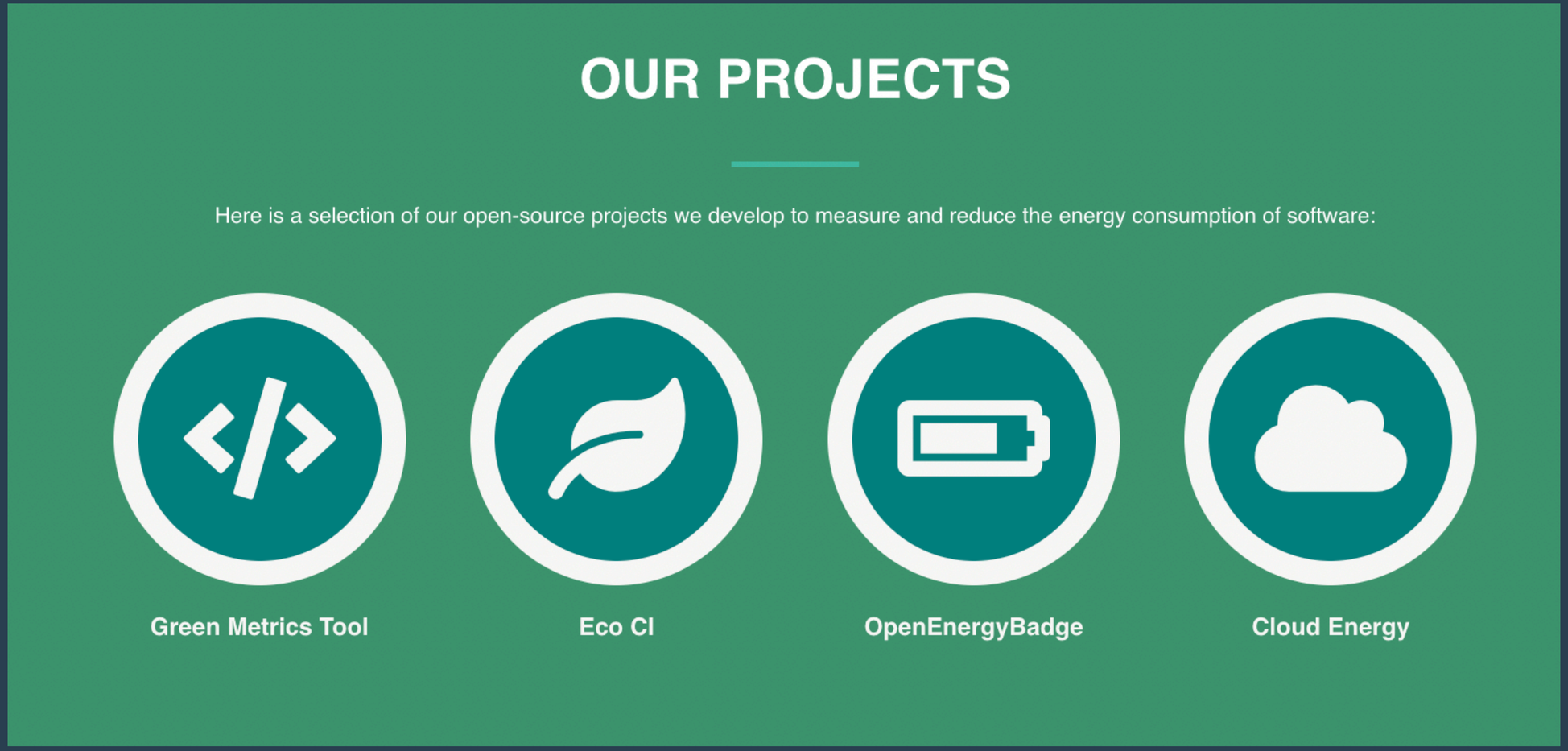


We try to build these tools

https://www.green-coding.berlin/#projects

We build open source tools

To empower developers and users to make energy and carbon concious decisions



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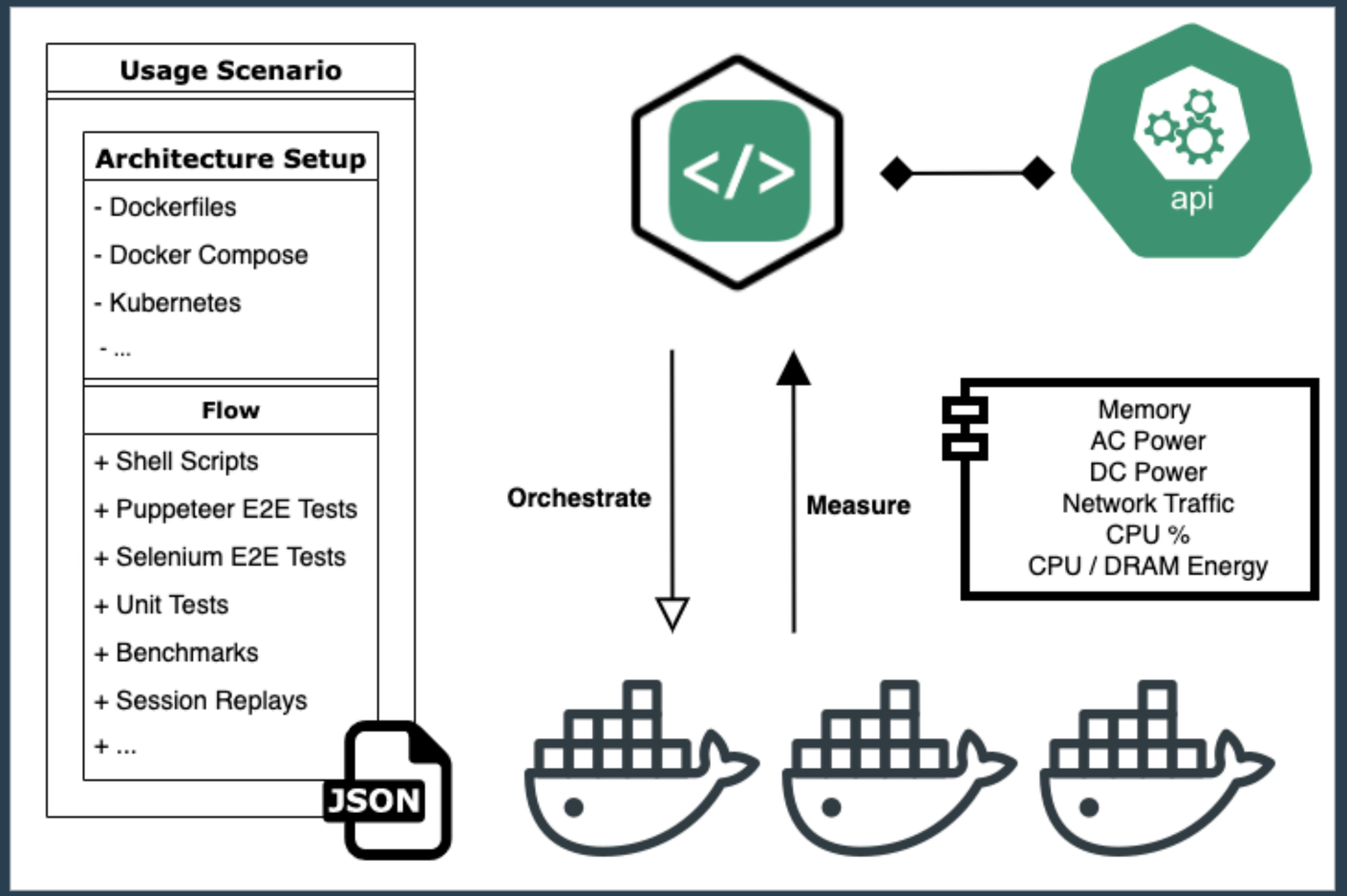
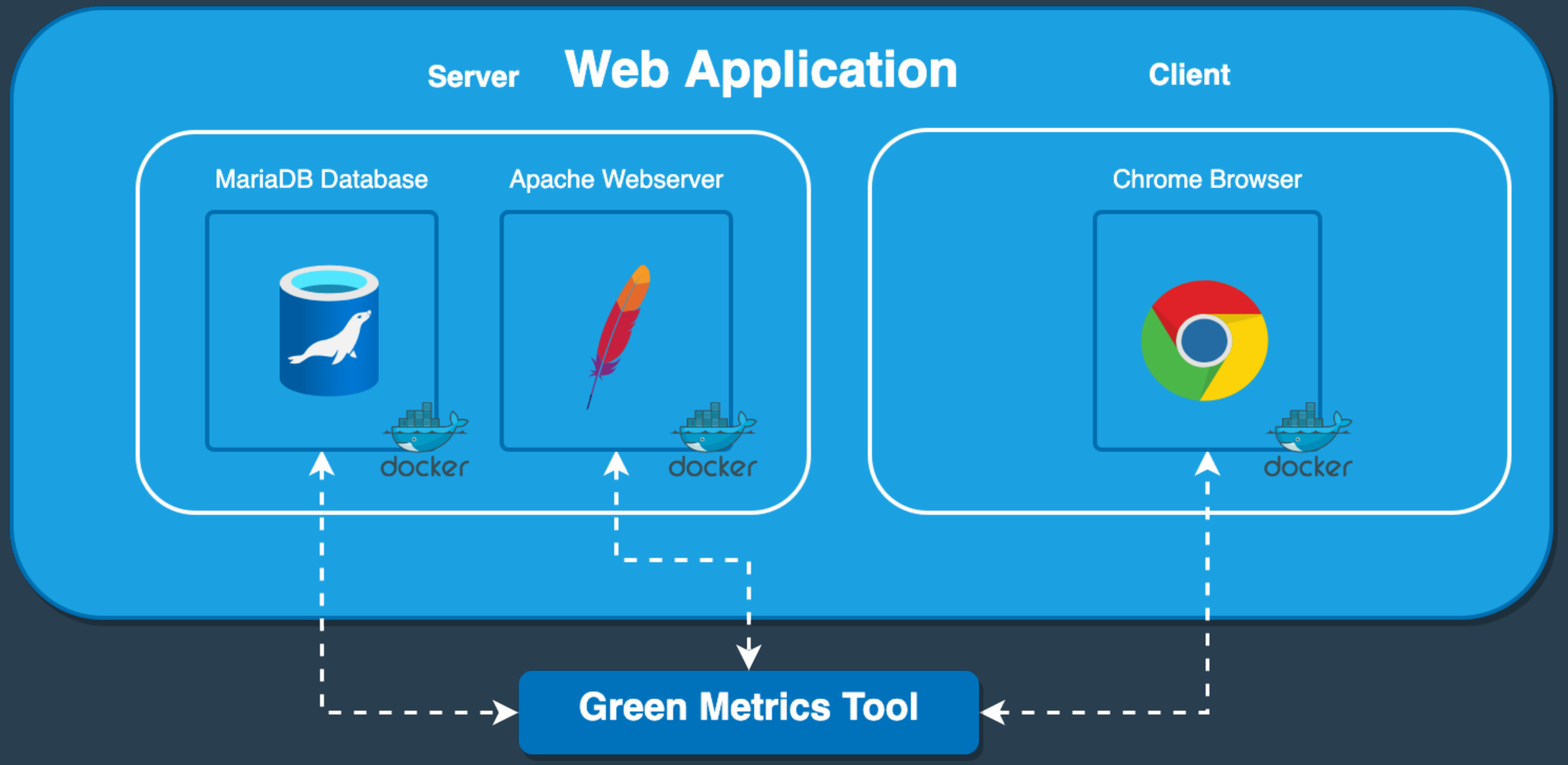
Data Flow in Framework

Ingesting standard infrastructure files. Output as POSIX stream



Concepts of the Green Metrics Tool

Adoption of container approach. Every functionality is a container



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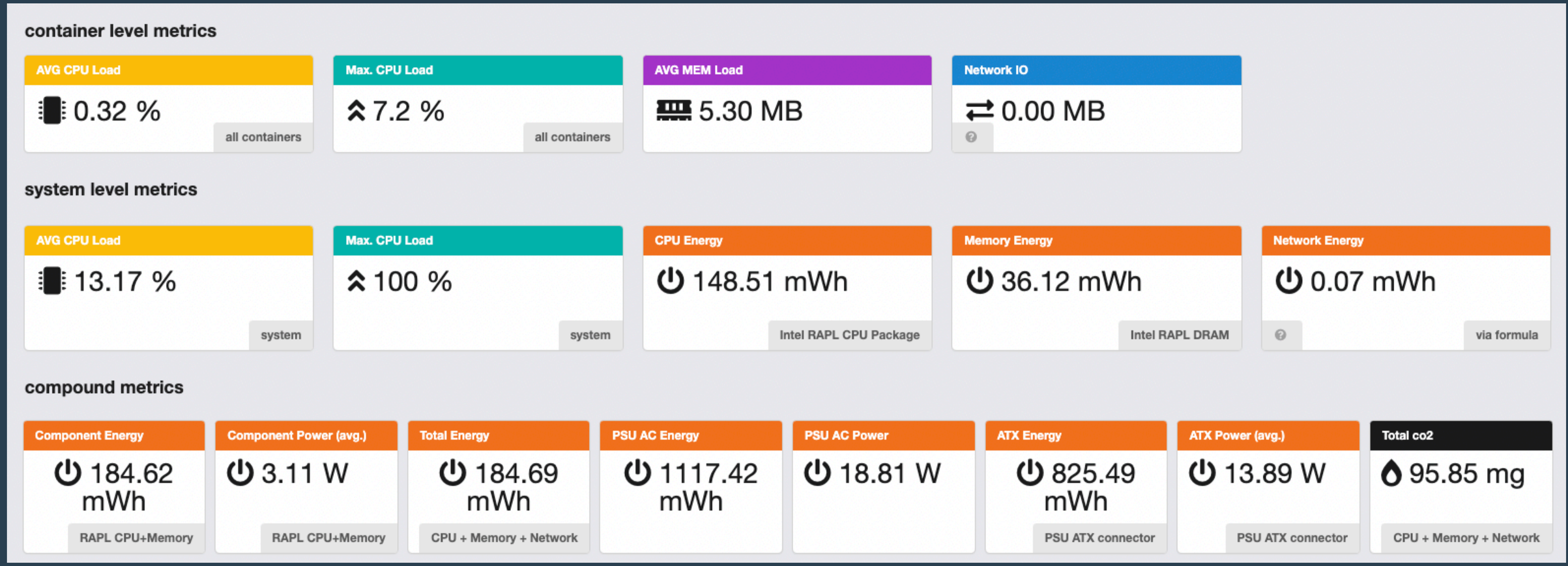
What the output looks like

Container, System and compound metrics



All reporters are modular and stand-alone

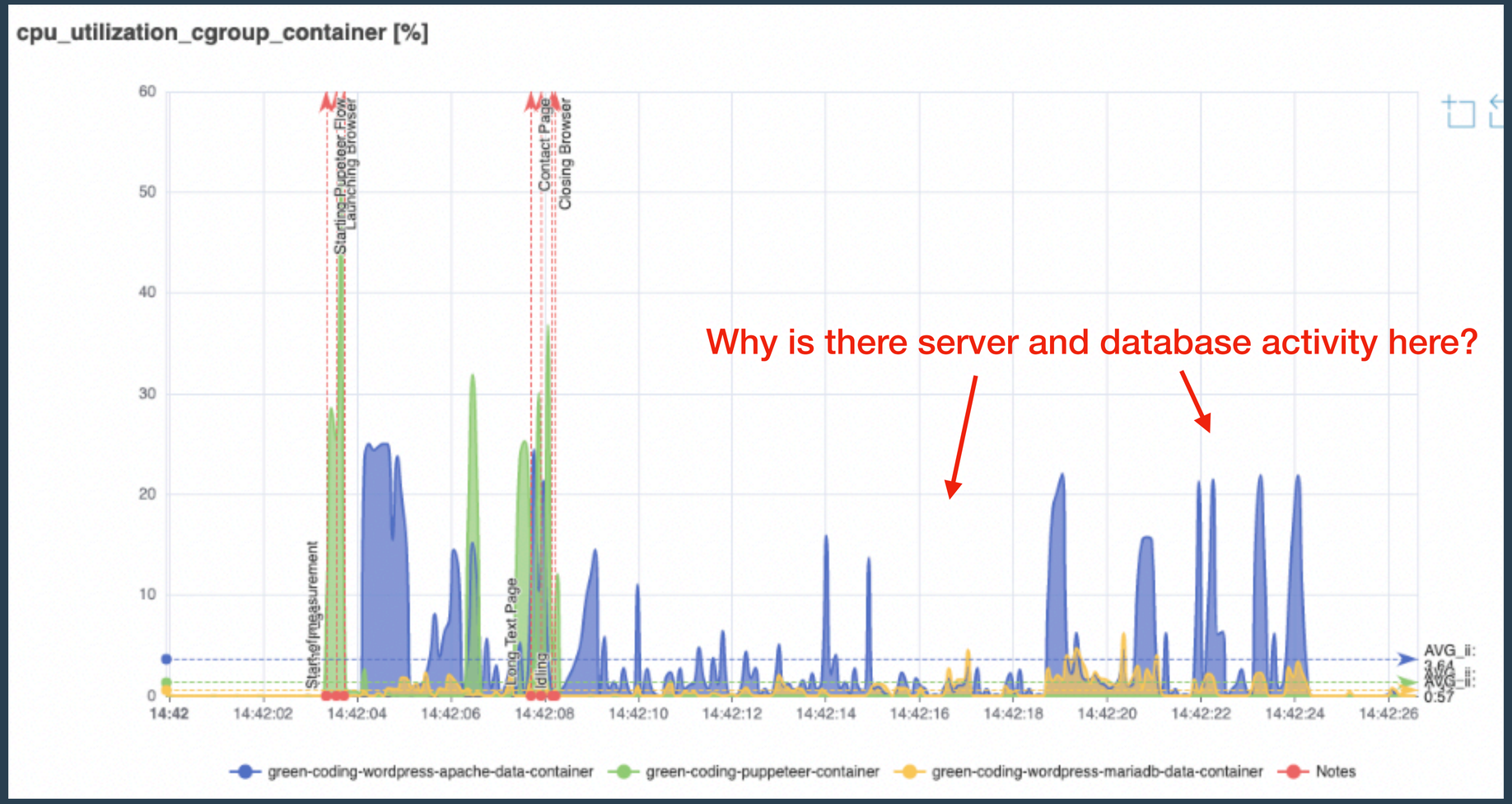
Network, DC, AC, Memory, CPU, Energy etc.

Project Data

General | Measurement | Machine | usage_scenario

idle-time-end	5
idle-time-start	5
psu.energy.ac.system.provider.PsuEnergyAcSystemProvider	100
cpu.energy.RAPL.MSR.system.provider.CpuEnergyRaplMsrSystemProvider	100
network.io.cgroup.container.provider.NetworkIoCgroupContainerProvider	100
memory.energy.RAPL.MSR.system.provider.MemoryEnergyRaplMsrSystemProvider	100
cpu.utilization.procfs.system.provider.CpuUtilizationProcfsSystemProvider	100
memory.total.cgroup.container.provider.MemoryTotalCgroupContainerProvider	100
cpu.utilization.cgroup.container.provider.CpuUtilizationCgroupContainerProvider	100
flow-process-runtime	600

Idle time optimizations in web applications



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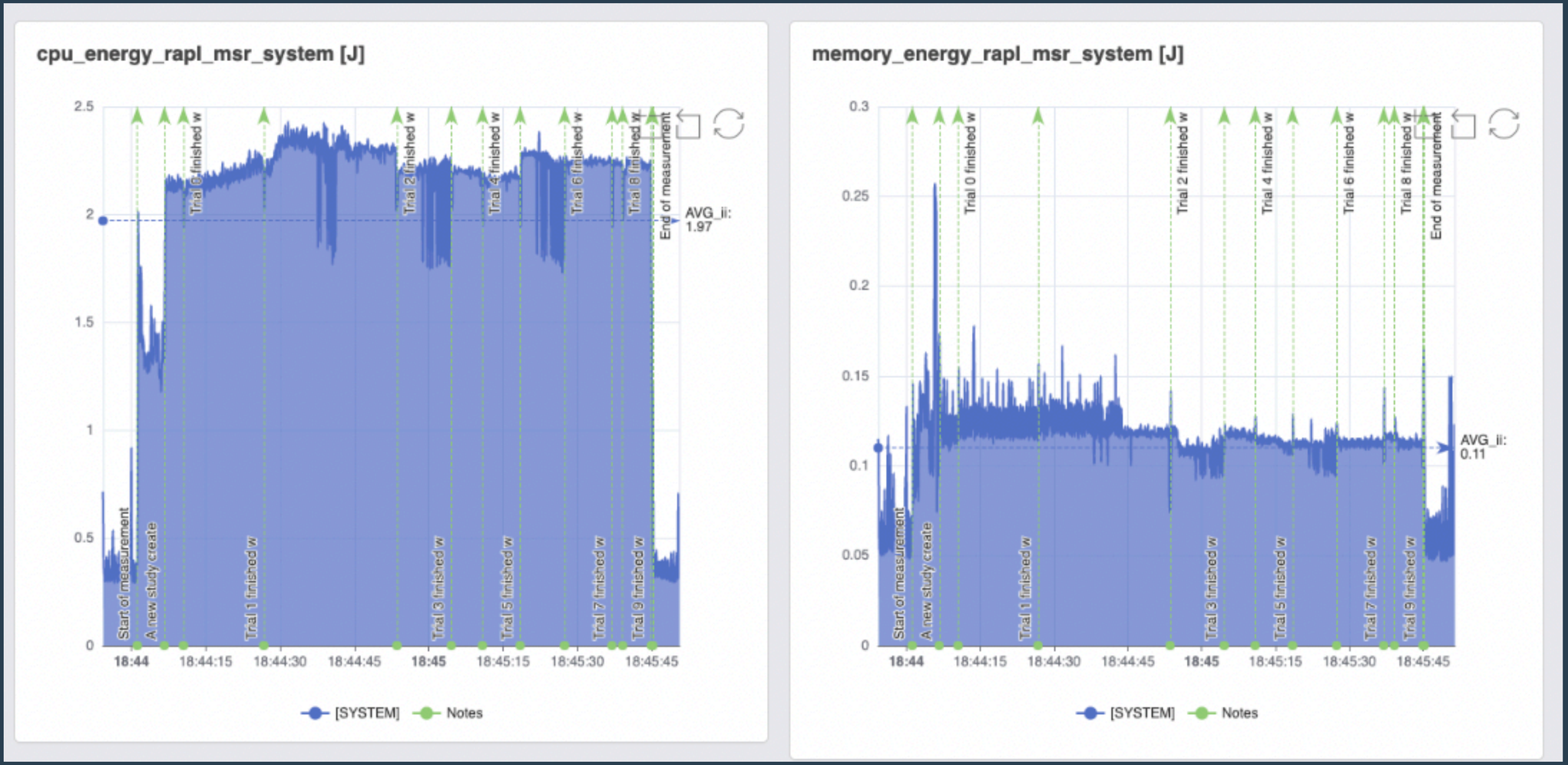
Energy anomalies in Machine Learning

Energy anomalies through TurboBoost and Overheating



Open Data & Transparency for software CO2

Think of it as the "Yuka" / "Codecheck" of Software

- Whenever you want to install a new software you check the Green Coding website first:
  - How much does this software consume?
  - Is there a more carbon friendly alternative?
  - Is there a software that makes less network requests?

Let me show you our other tools

That we believe are needed to build ecosystems around green software

https://www.green-coding.berlin/#projects

Wrapping up

Why are we creating these open source tools?

- Measuring software energy consumption is still too hard.
  - Goal: Easy as starting a docker container and happen transparently
- Measuring software is complex
  - Best practices and system configuration should be automatically applied
- Just in-line measuring or benchmarking is too arbitrary
  - The software must be measured against a "standard usage case"

Wrapping up #2

Why are we creating these open source tools?

- A software must be comparable to another, similar, software in terms of energy
- Energy metrics must also be available in restricted environments like the cloud
- Energy must be transparent and a first oder metric in developing and using software

Thank you!

Time for questions!!

Want to support the project or more details?

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- Check out our website and blog & newsletter: https://www.green-coding.berlin
- Demo Open Data Repository: https://metrics.green-coding.berlin
- Our projects: https://www.green-coding.berlin/#projects

- Meetup group: https://www.meetup.com/green-coding

- We are looking for funding / grants :)

- https://www.linkedin.com/in/arne-tarara / arne@green-coding.berlin

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