

Sustainable design for backend development

Or how to make your backend more efficient



DATADOG



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VECTOR
BY DATADOG



Why should I build sustainable products?

The Footprint

67 million of hosted servers

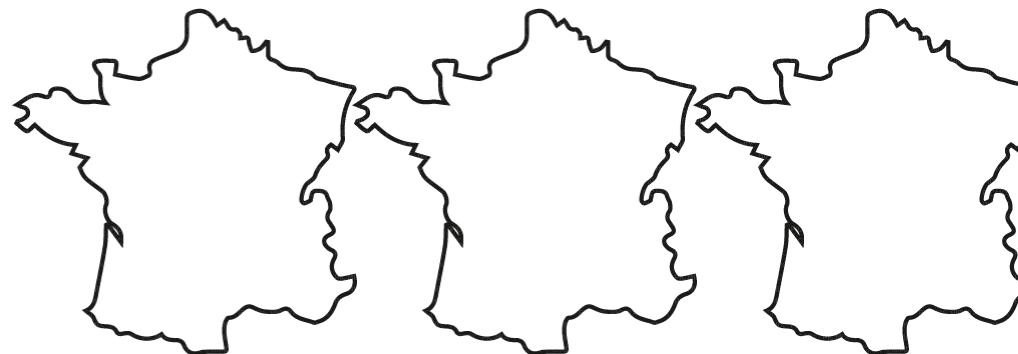
4.1 billion users

Each user has, in average, **8 devices**

All these devices weight around **223 million tons** of hard to recycle materials

The Footprint

Water consumption	Greenhouse effect gas emission	Primary energy consumption	Electricity consumption
0.2%	3.8%	4.2%	5.5%



The Footprint

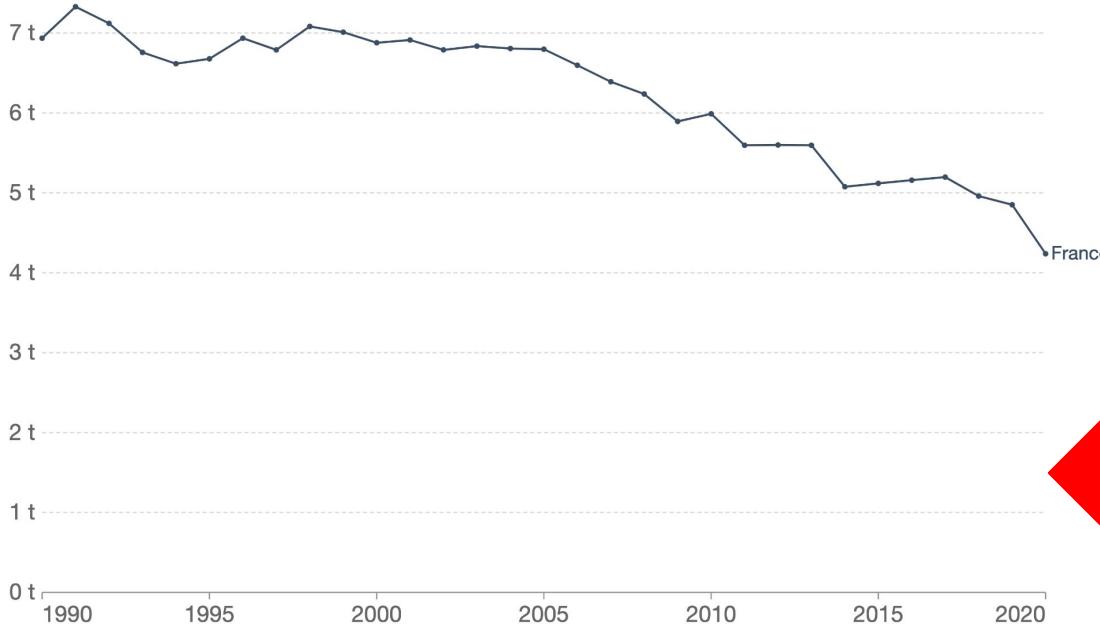


Why should we care about that?

Our Footprint

Per capita CO₂ emissions

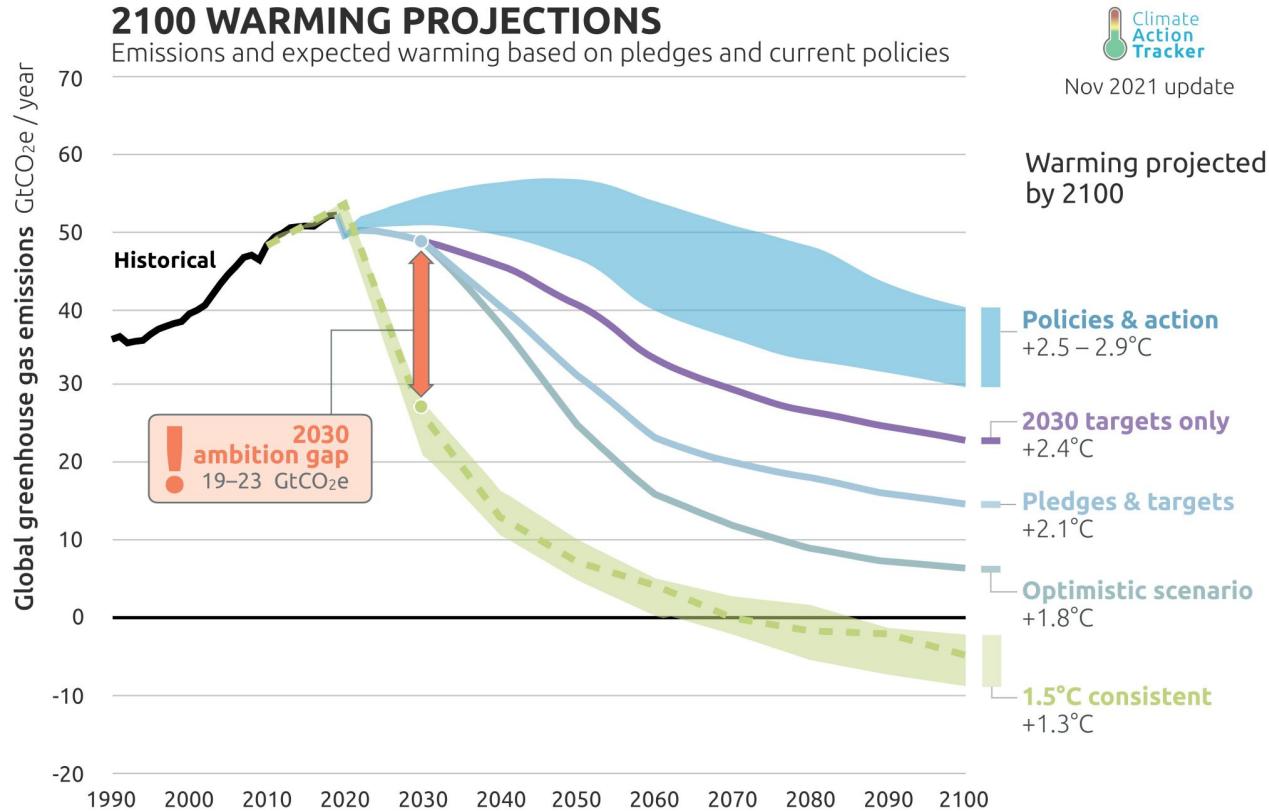
Carbon dioxide (CO₂) emissions from the burning of fossil fuels for energy and cement production. Land use change is not included.



Source: Our World in Data based on the Global Carbon Project
Note: CO₂ emissions are measured on a production basis, meaning they do not adjust for emissions embedded in traded goods.

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

Our Footprint

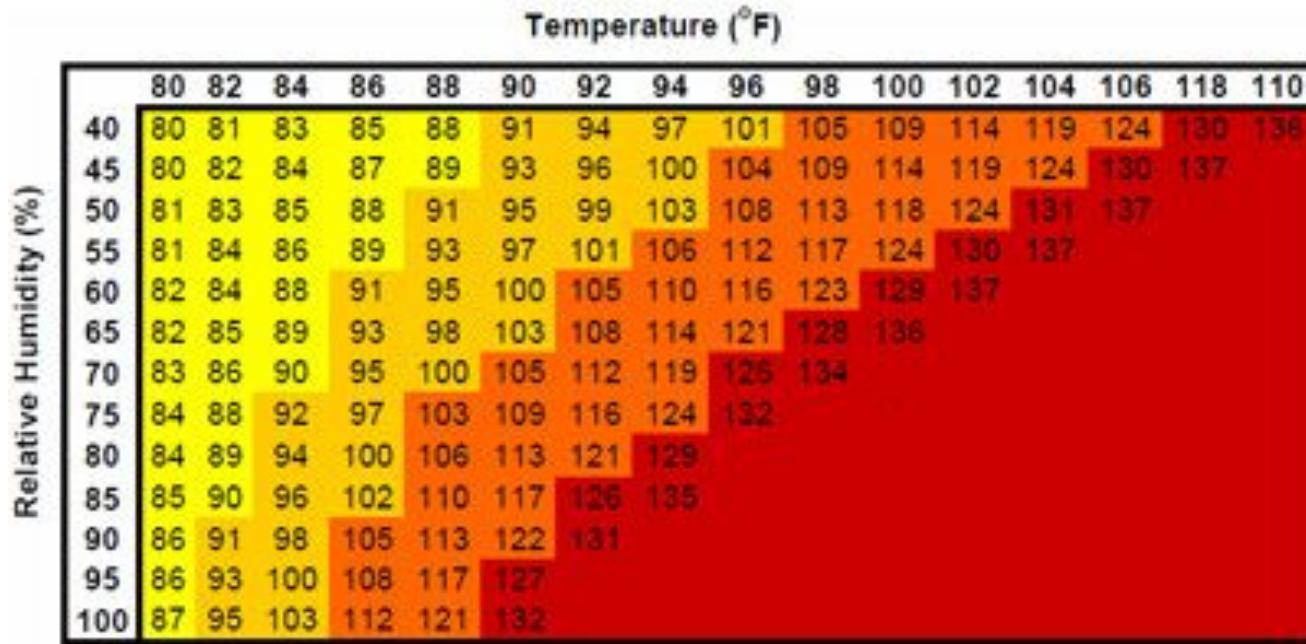


Nov 2021 update

Floods are coming



Humidity is coming



26.7°C

32.2°C

37.8°C

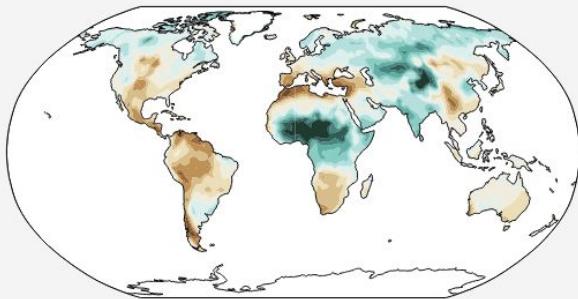
43.3°C

Humidity is coming

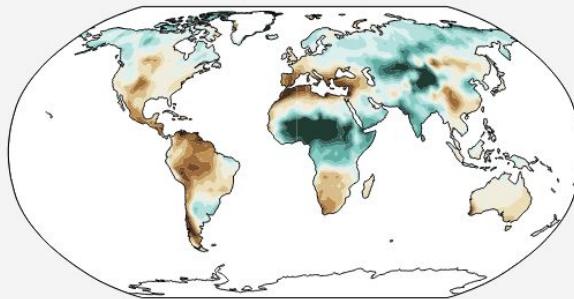
(d) Annual mean total column soil moisture change (standard deviation)

Across warming levels, changes in soil moisture largely follow changes in precipitation but also show some differences due to the influence of evapotranspiration.

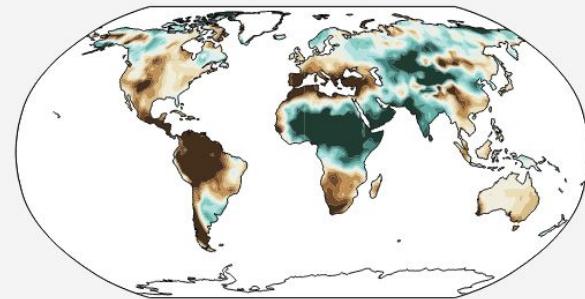
Simulated change at 1.5°C global warming



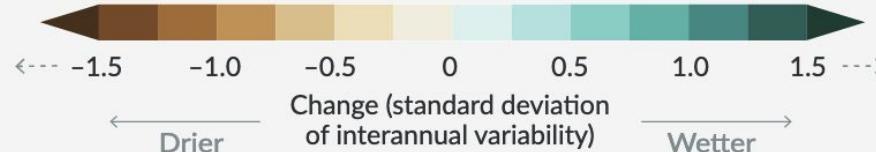
Simulated change at 2°C global warming

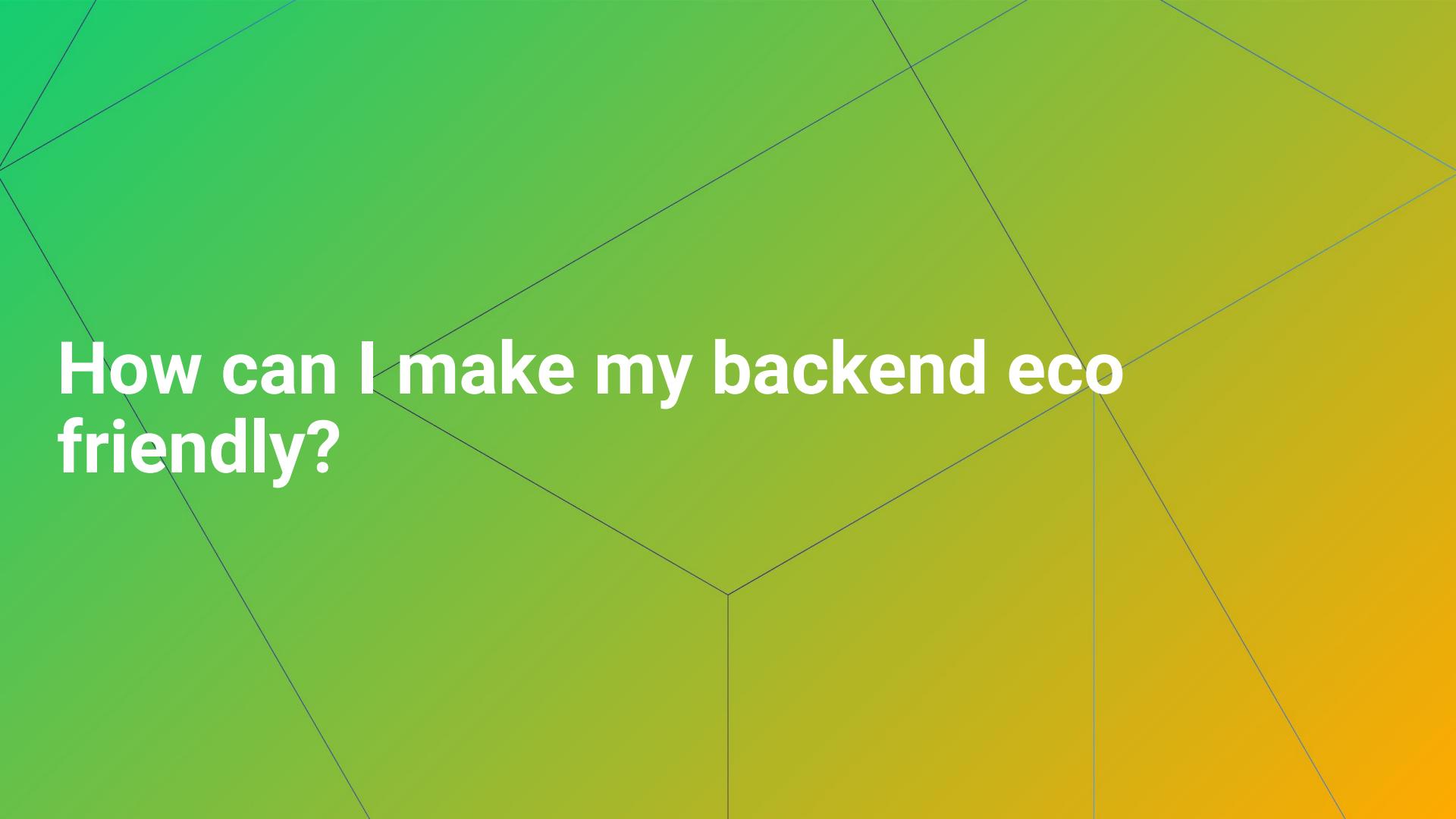


Simulated change at 4°C global warming



Relatively small absolute changes may appear large when expressed in units of standard deviation in dry regions with little interannual variability in baseline conditions.





How can I make my backend eco friendly?

Where to start from...?



Energy Efficiency across
Programming Languages
How Do Energy, Time, and Memory Relate?

<https://colibris.link/5TR2P>

Where to start from...?

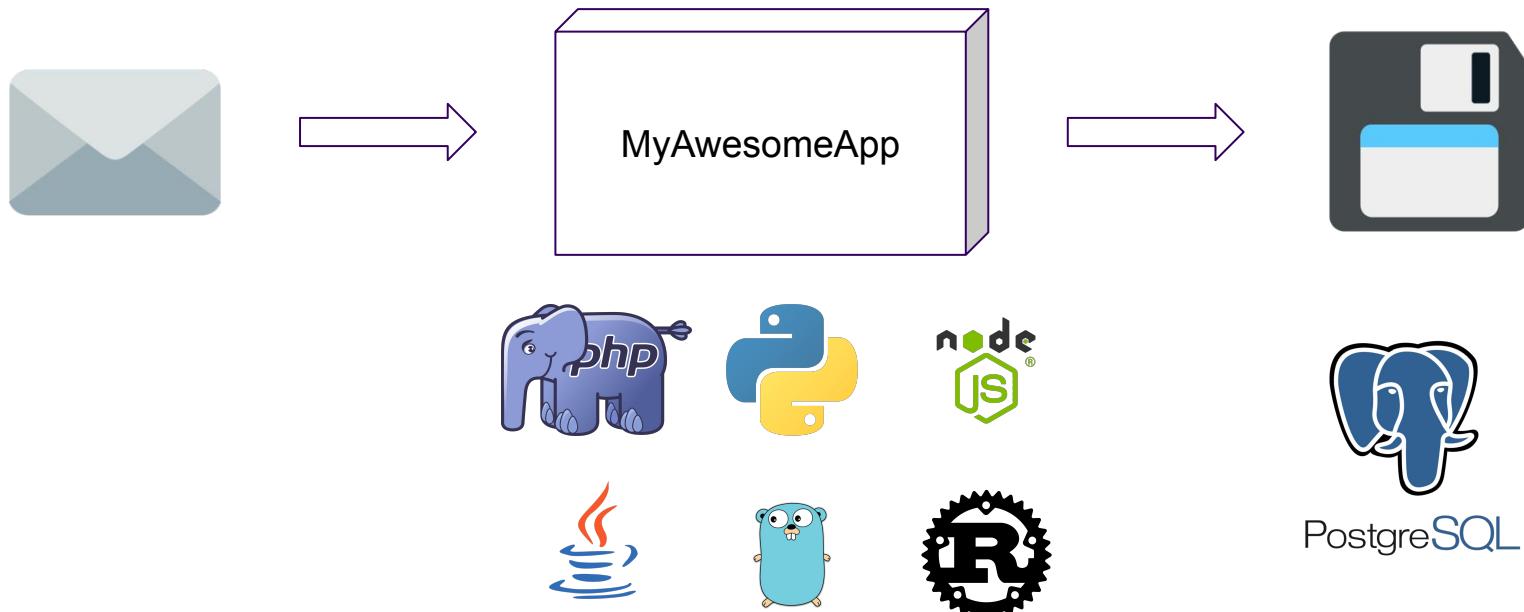
Table 5. Pareto optimal sets for different combination of objectives.

Time & Memory	Energy & Time	Energy & Memory	Energy & Time & Memory
C • Pascal • Go	C	C • Pascal	C • Pascal • Go
Rust • C++ • Fortran	Rust	Rust • C++ • Fortran • Go	Rust • C++ • Fortran
Ada	C++	Ada	Ada
Java • Chapel • Lisp • Ocaml	Ada	Java • Chapel • Lisp	Java • Chapel • Lisp • Ocaml
Haskell • C#	Java	OCaml • Swift • Haskell	Swift • Haskell • C#
Swift • PHP	Pascal • Chapel	C# • PHP	Dart • F# • Racket • Hack • PHP
F# • Racket • Hack • Python	Lisp • Ocaml • Go	Dart • F# • Racket • Hack • Python	JavaScript • Ruby • Python
JavaScript • Ruby	Fortran • Haskell • C#	JavaScript • Ruby	TypeScript • Erlang
Dart • TypeScript • Erlang	Swift	TypeScript	Lua • JRuby • Perl
JRuby • Perl	Dart • F#	Erlang • Lua • Perl	
Lua	JavaScript Racket	JRuby	
	TypeScript • Hack PHP Erlang		
	Lua • JRuby		
	Ruby		

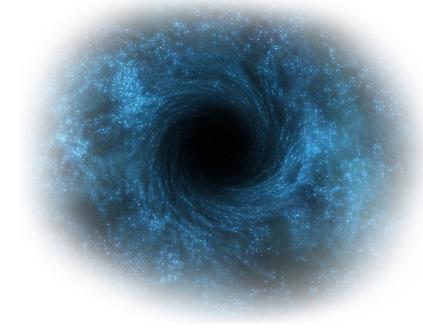
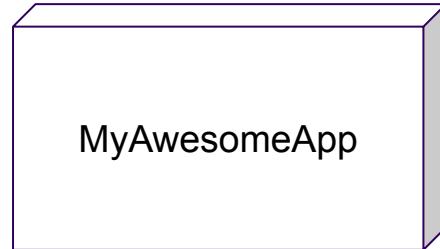
The question

**What language is the
most eco friendly for
backend development?**

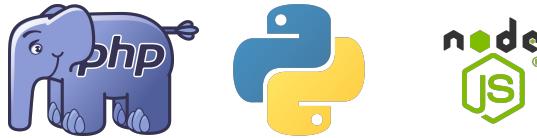
The methodology - First attempt



The methodology - Second attempt



<https://github.com/rakyll/hey>



<https://github.com/blt/lading>



The methodology - Second attempt

```
# [get("/")]
async fn handle_status() -> HttpResponse {
    HttpResponse::NoContent().finish()
}
```

The methodology - Second attempt

```
#[post("/publish")]
pub async fn handle_publish(
    blackhole: web::Data<Blackhole>,
    payload: web::Json<Event>,
) -> HttpResponse {
    let mut payload = payload.into_inner();
    payload.tags.insert("through".into(), "rust".into());
    match blackhole.publish(payload).await {
        Ok(_) => HttpResponse::NoContent().finish(),
        Err(err) => HttpResponse::InternalServerError().json(&err),
    }
}
```

How to measure the energy consumption?



How to measure the energy consumption?



Scaphandre

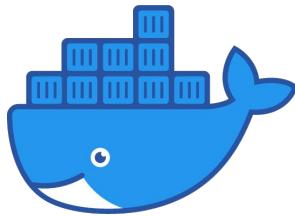
<https://github.com/hubblo-org/scaphandre>

How to measure the energy consumption?



Powercap

<https://crates.io/crates/powercap>



Docker Activity

<https://github.com/jdrouet/docker-activity>



How will I measure it?



AMD Ryzen 5 5600X 6-Core
32Go of Ram



Intel(R) Core(TM) i7-4710HQ CPU
@ 2.50GHz
16Go of Ram

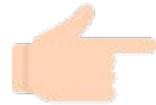
What will I measure?

The cost of the build + requests for n
requests

Energy consumed per build

Energy consumed per request

How will I measure it?



Build docker image



Execute 1M GET requests on 50 threads



Execute 1M POST requests on 50 threads

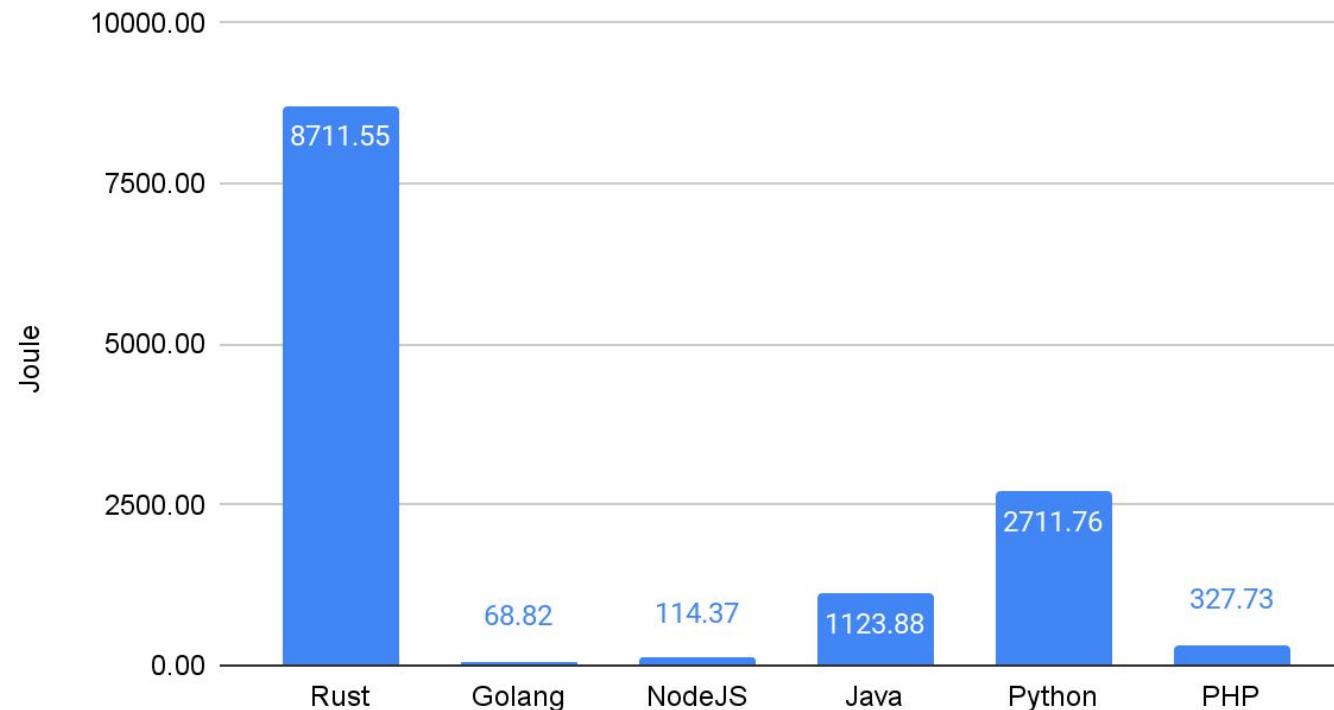
```
{"ts":1636118098,"tags":{"foo":"bar"},"values":{"answer":42}}
```



Chart time!

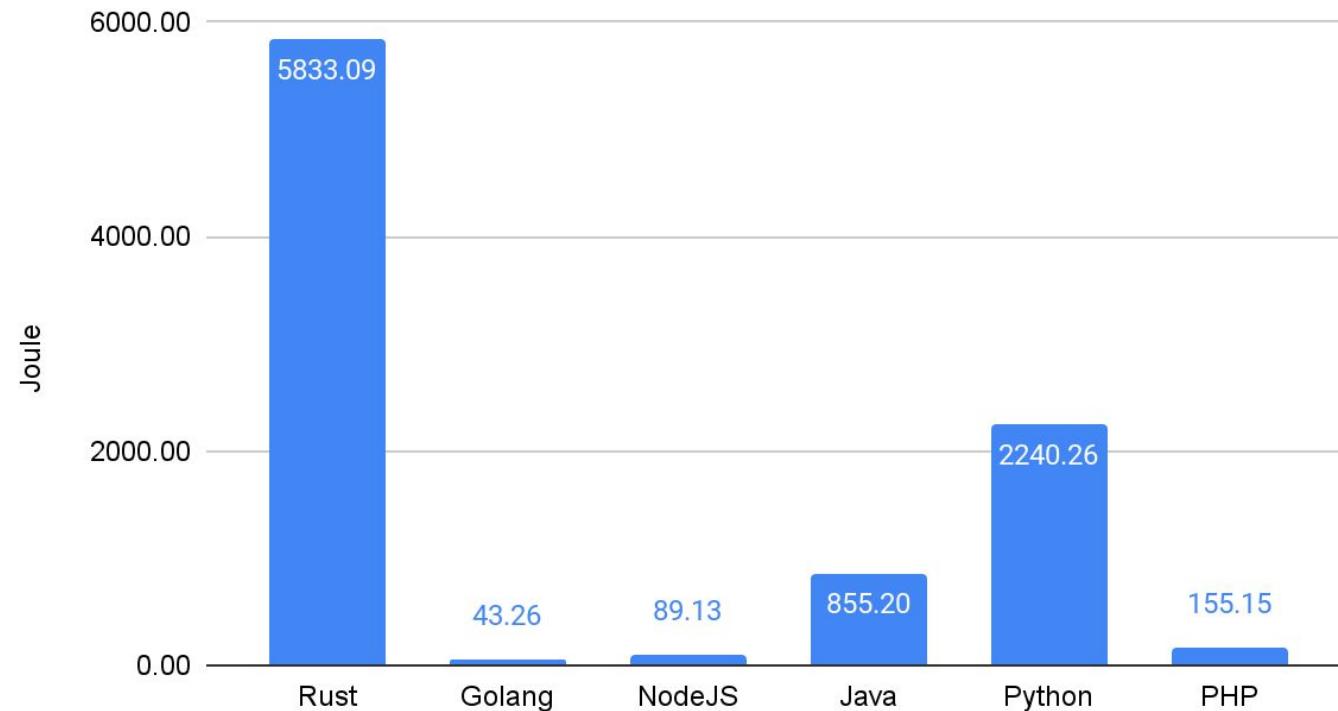
Build cost

Build comsumption - Intel i7



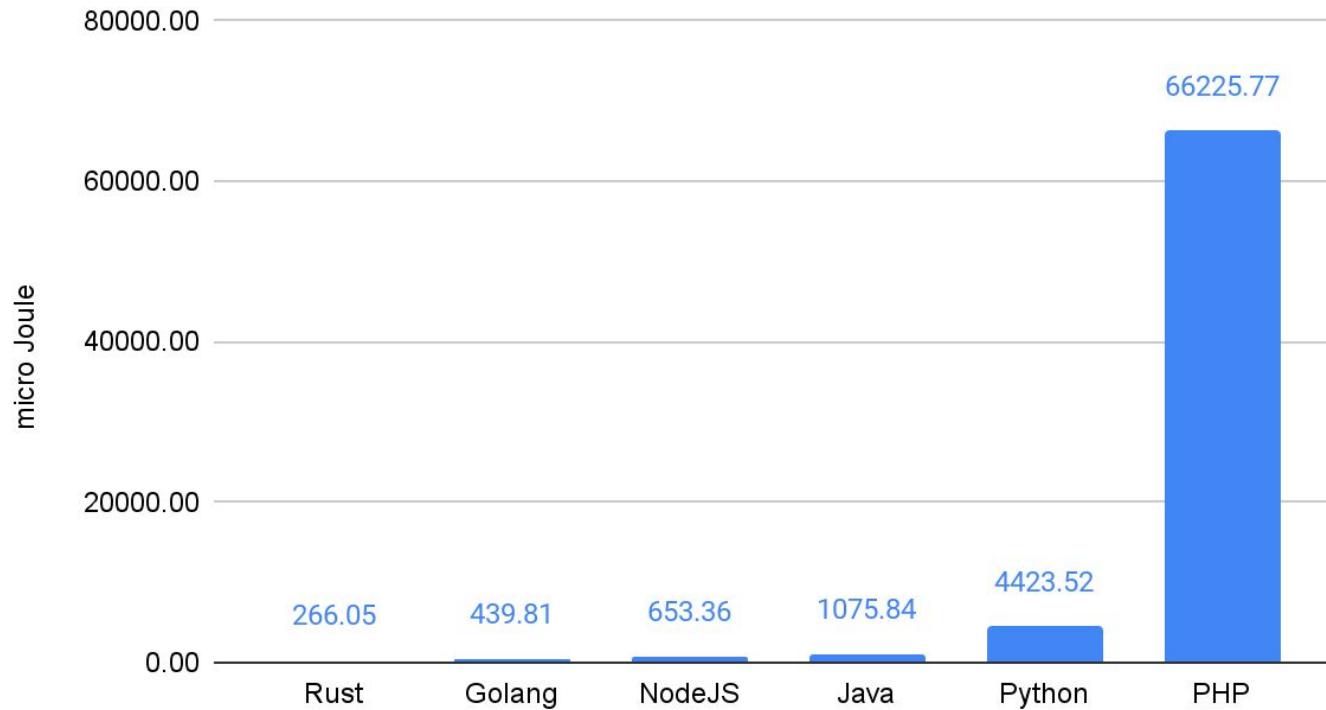
Build cost

Build comsumption - AMD



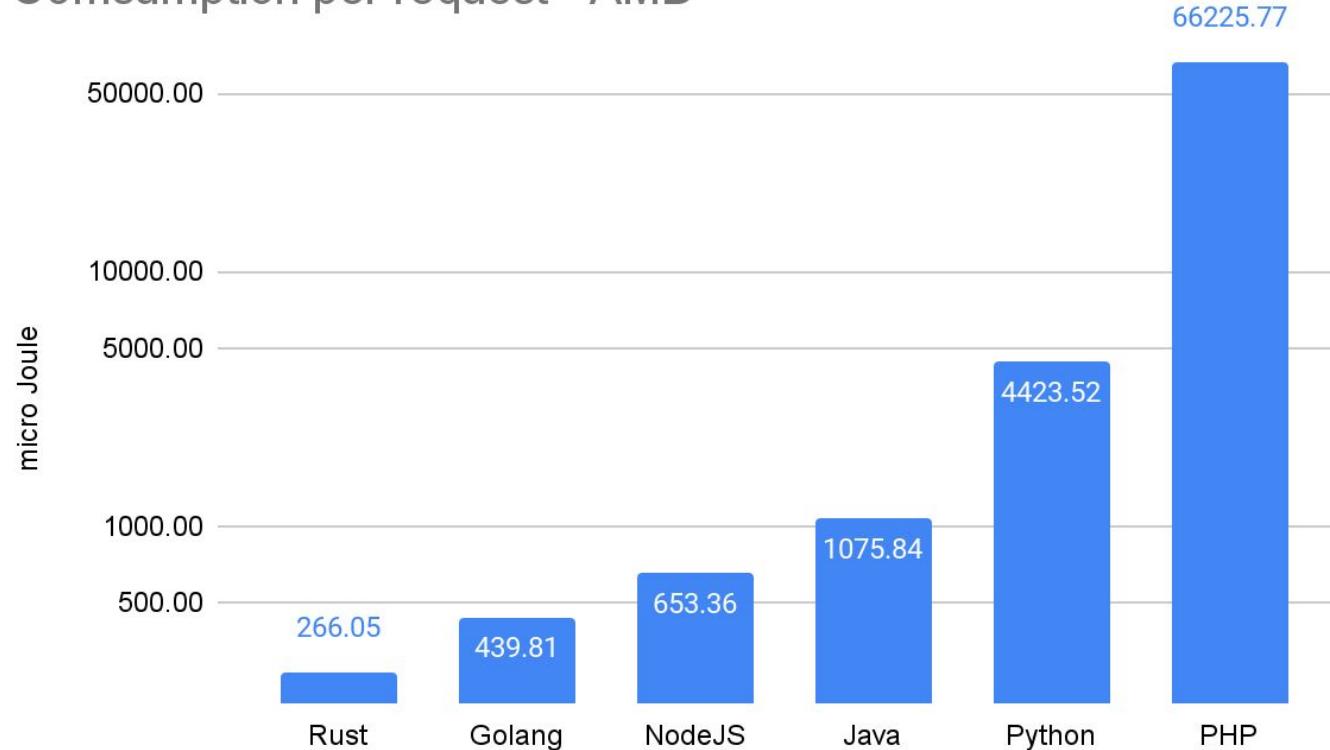
Cost By request

Comsumption per request - AMD Ryzen 5



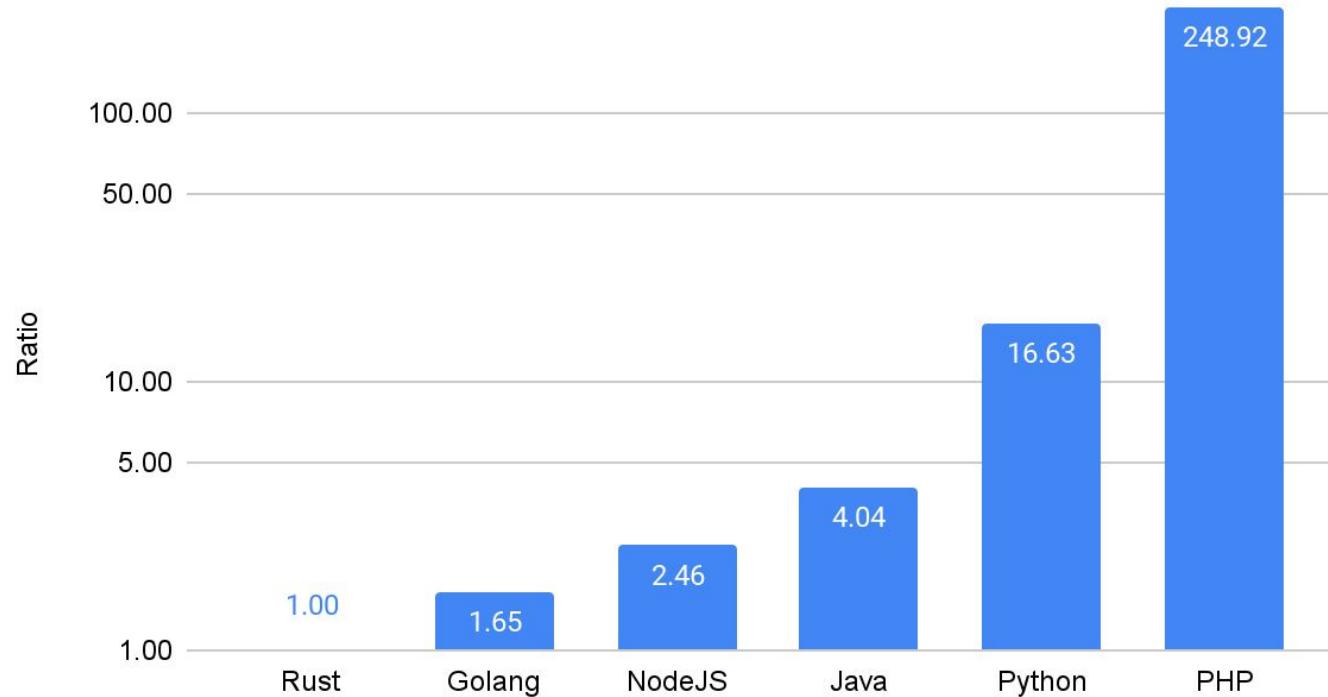
Cost By request

Comsumption per request - AMD



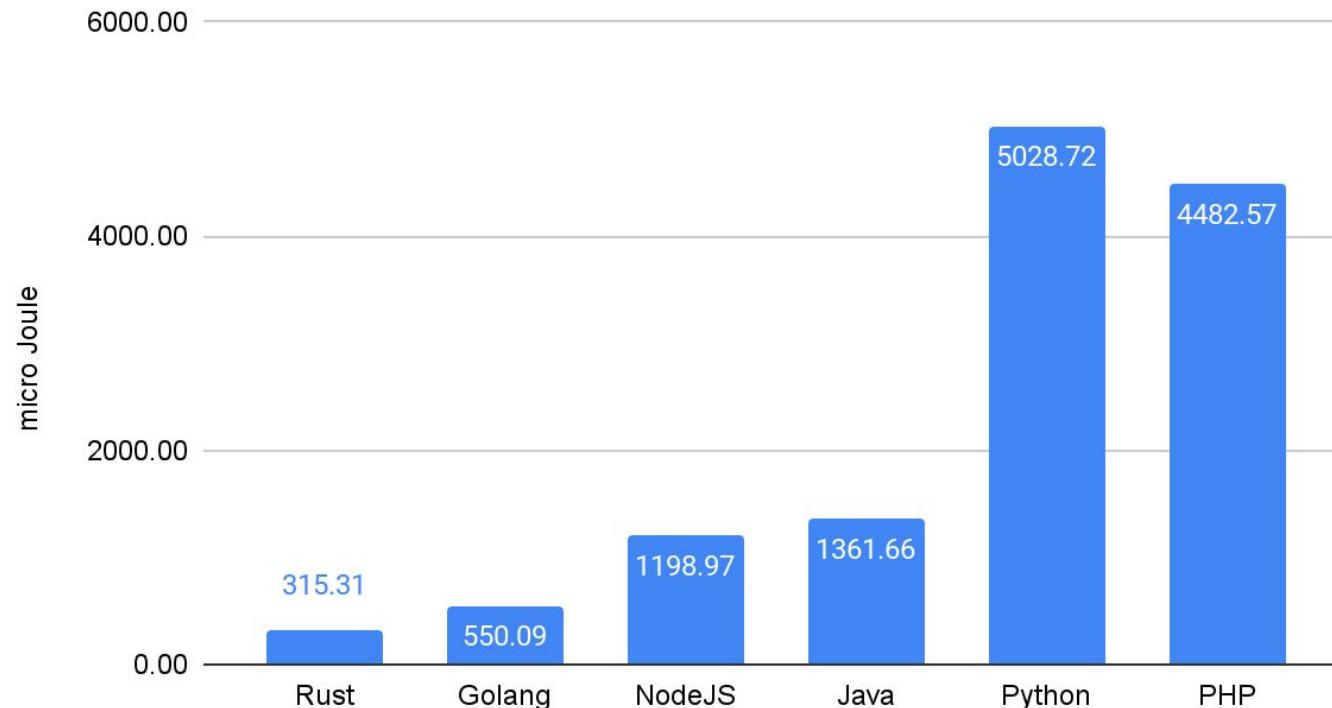
Cost By request

Ratio with best language on AMD



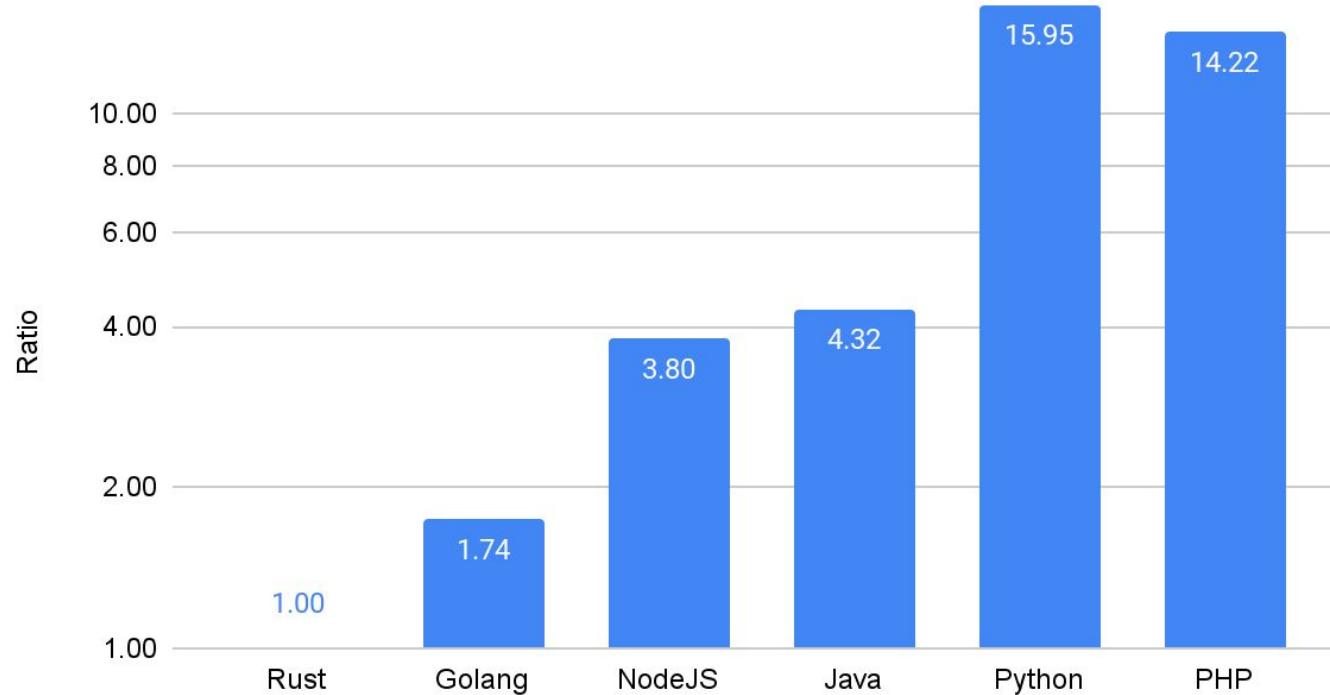
Cost By request

Comsumption per request - Intel i7



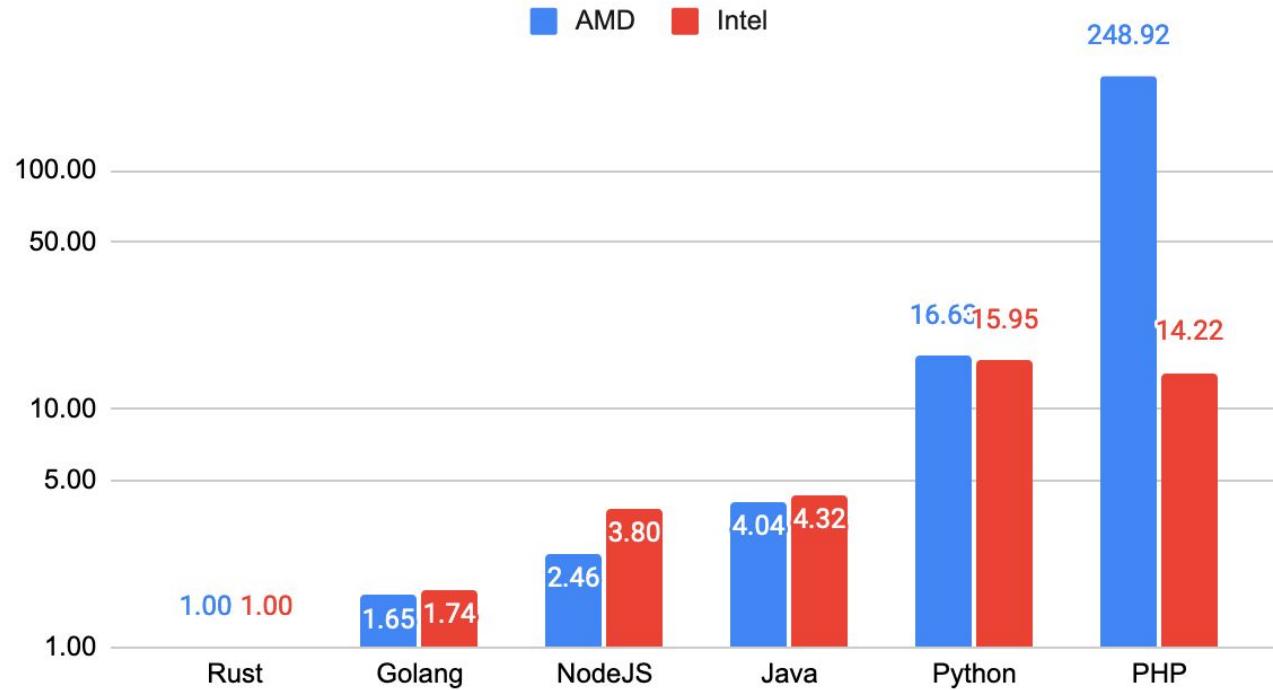
Cost By request

Ratio with best language on Intel



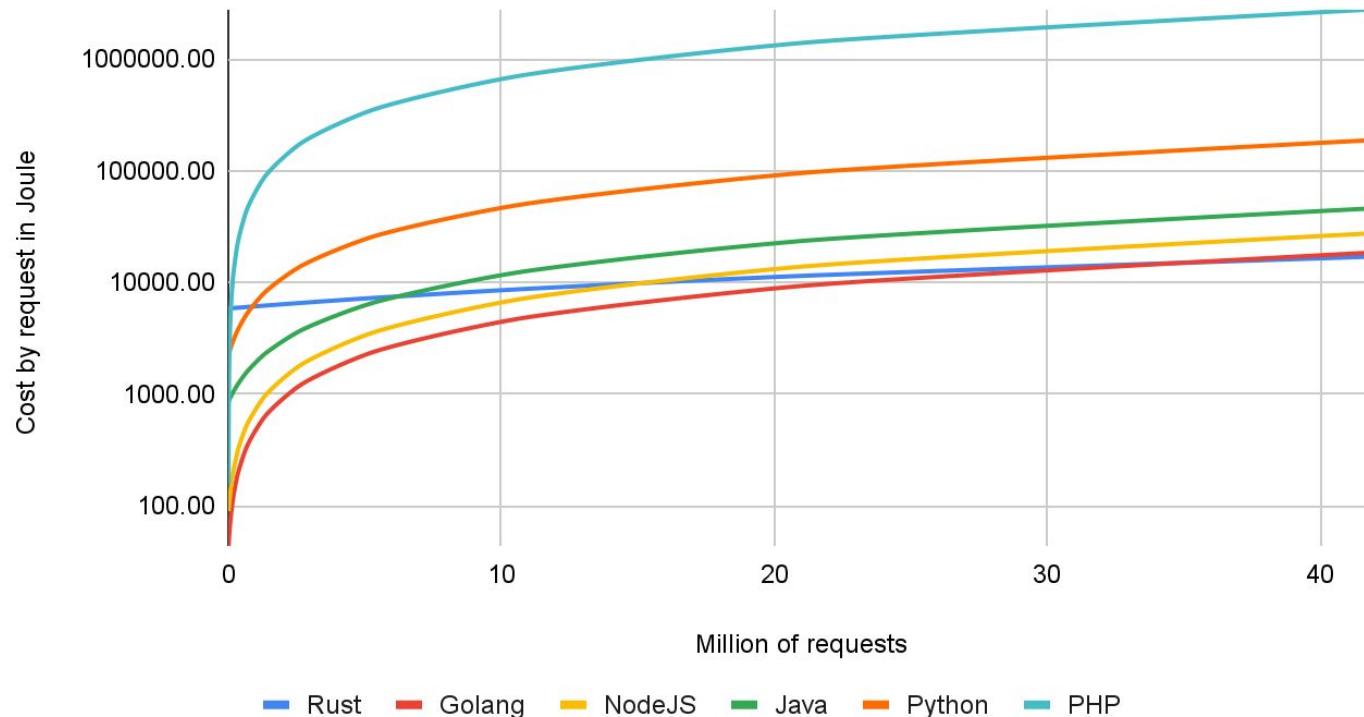
Cost by request

Ratio with best lang



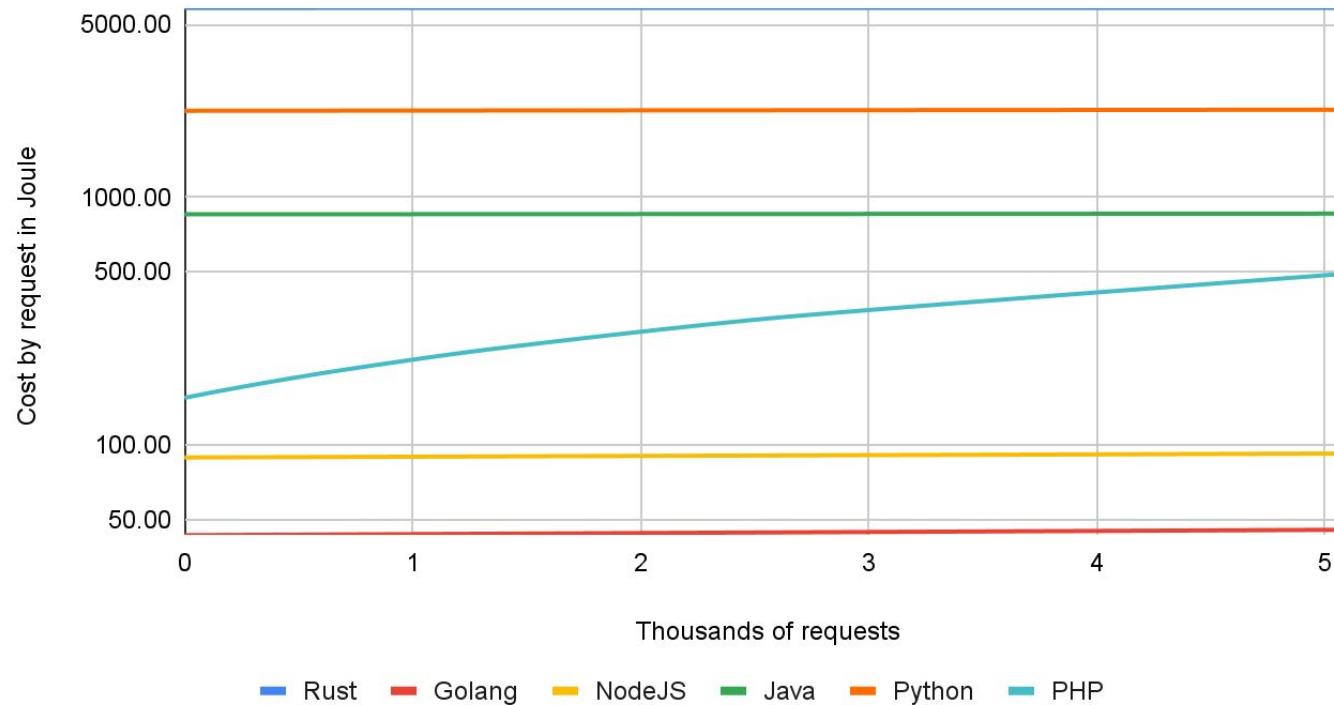
Cost By request, build included

Cost by request evolution - AMD Ryzen 5



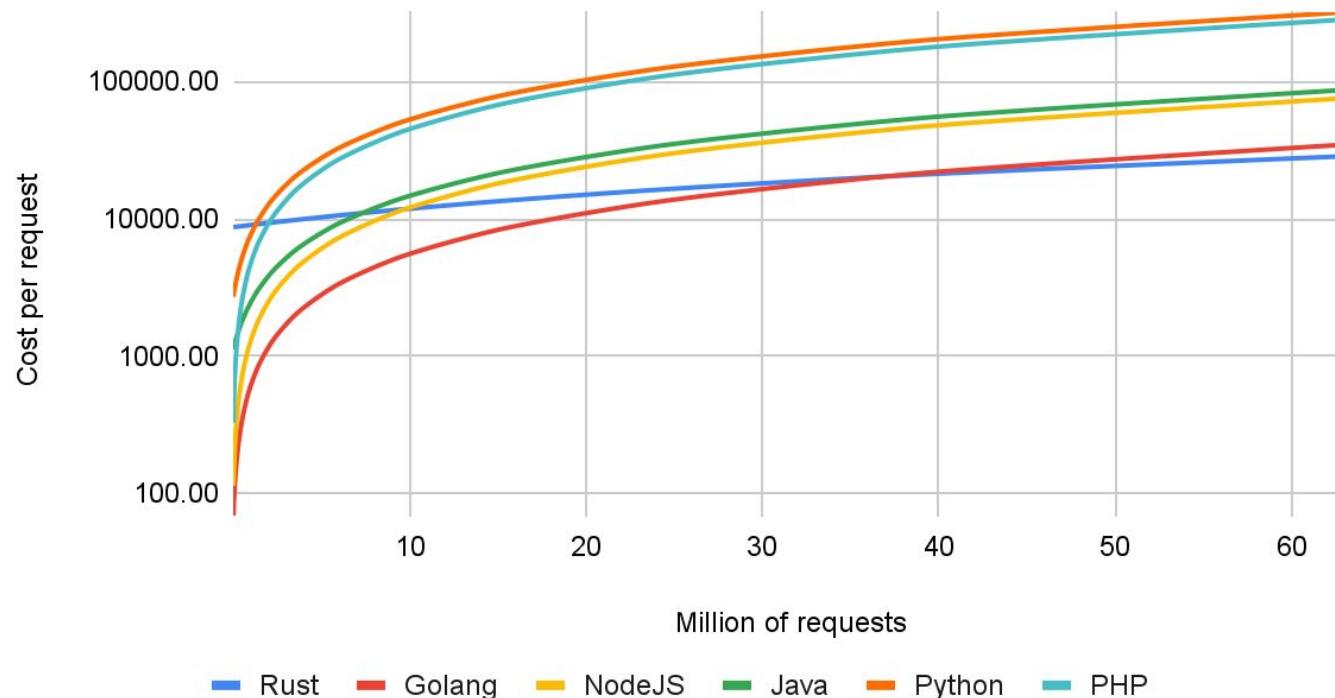
Cost By request, build included

Cost by request evolution - AMD Ryzen 5



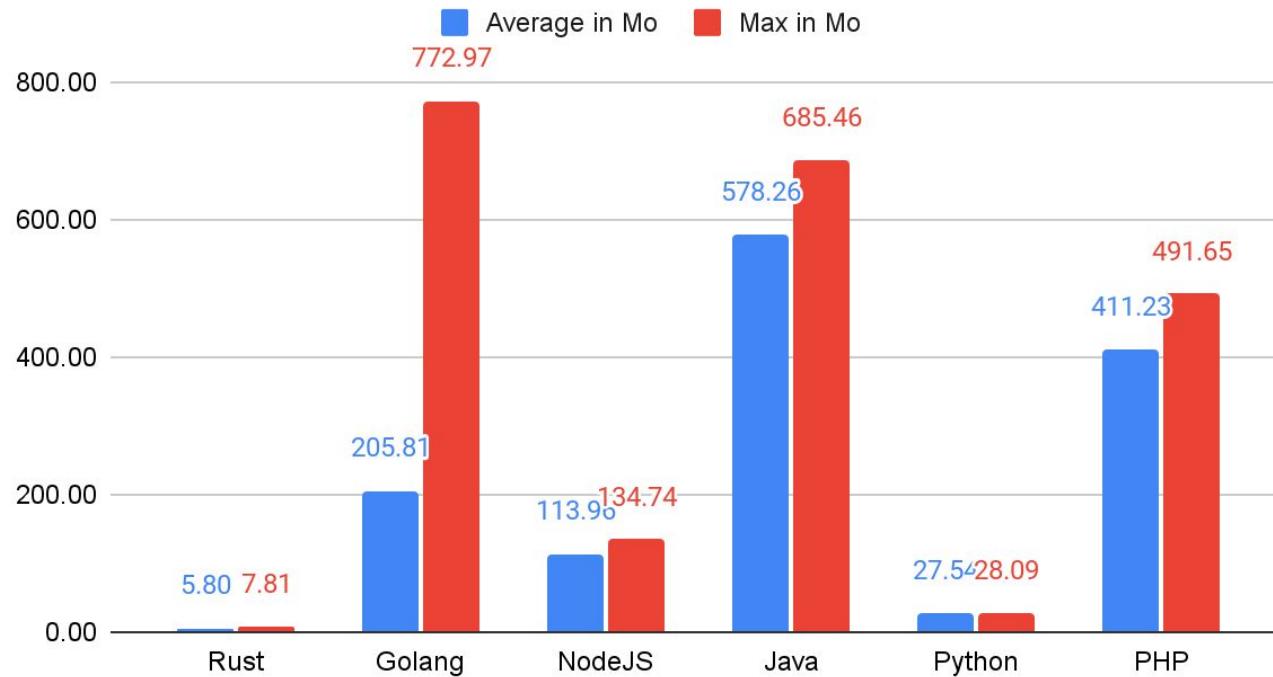
Cost By request, build included

Cost by request evolution - Intel i7



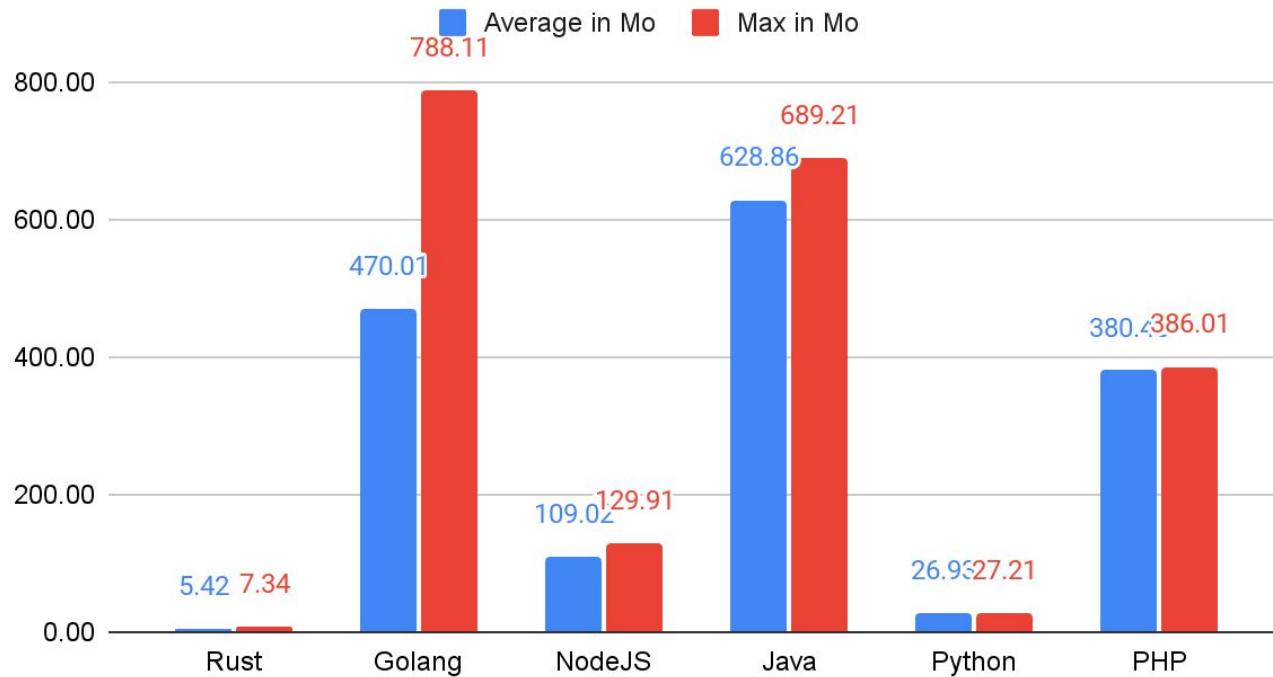
What about the RAM

Memory usage on AMD



What about the RAM

Memory usage on Intel



What should we conclude about all that

The right tool for job

Distributed product (Postgres, Redis, Elasticsearch, Vector, ...)

- Performance is highly important
- Minimal footprint
- Build time becomes less important
- Multiplatform

In house / saas product (Doctolib, banking servers, ...)

- Build time is important

Be careful about the side effects

- Don't waste the energy you gain on something useless
- Optimise your code when you push it in production
- The best energy is the one you didn't spend

What's next

- Find a way to monitor consumption on more than just the CPU
- Test on more platforms
- Implement more connectors
- Write a paper about it

Thank you for your attention!

Resources

Energy Efficiency across Programming Languages
How Do Energy, Time, and Memory Relate?
<https://colibris.link/5TR2P>

Climate Action Tracker
<https://climateactiontracker.org/>

Green IT report (FR)
<https://colibris.link/wtl6B>

Sea level elevation map
<https://coastal.climatecentral.org/>

Heat index chart
<https://colibris.link/Du4X9>

GIEC report
<https://colibris.link/BbSgW>



The presentation

Reproduce the benchmarks
<https://github.com/jdrouet/eco-backend/>

PowerCap
<https://github.com/jdrouet/powercap>

Joule
<https://github.com/jdrouet/joule>

Docker activity
<https://github.com/jdrouet/docker-activity>