

# The Future is



## A Journey through the Energy Efficient Design Principles of Software Engineering

Ko Turk & Ionut Balosin





# ***Learnings***

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✓ What's in it for me?

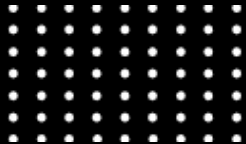
✓ Principles

✓ Tips on your:

- application
- code guidelines
- architecture
- web frontend

***“next video credits to”***

~ © European Union, 2023



© European Union, 2023





# blue4IT



**koturk77**



**ko-turk**



**koturk.nl**


## About Ko Turk

Developer (Java / Kotlin)

Speaker

Writing blog(s)

I'm not perfect





**Raiffeisen Bank  
International**



**IonutBalosin**



**IonutBalosin**



**IonutBalosin**

# About Ionut Balosin

Software architect

Independent technical trainer

Security champion

Speaker

Blogger

[www.IonutBalosin.com](http://www.IonutBalosin.com)

**Sharing is caring**



**Slides**

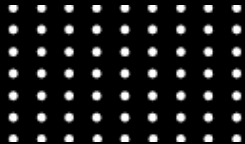


**Github**



***““More than 2% of global  
CO2 emissions we spend at  
running applications””***

~ from <https://8billiontrees.com>







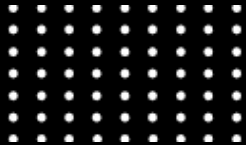


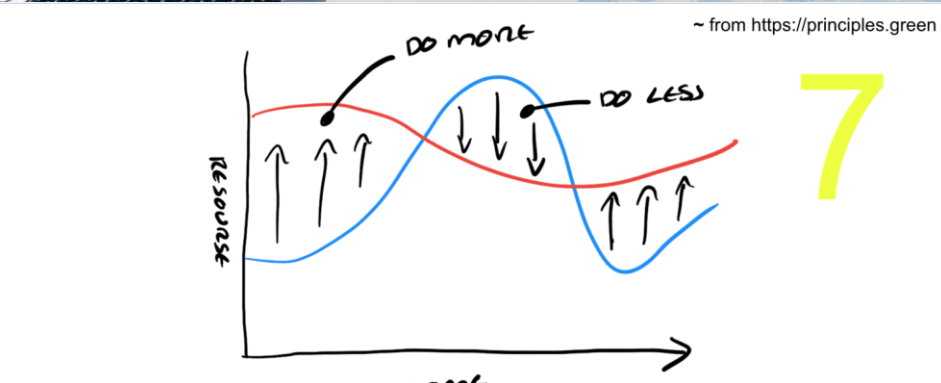
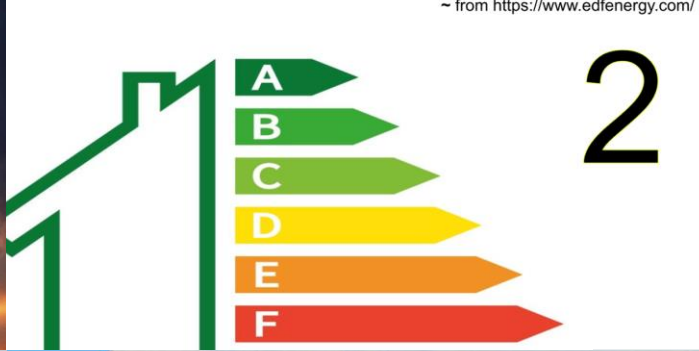
*Philosophy*



# *8 principles of Green Software Engineering*

~ from <https://principles.green/>



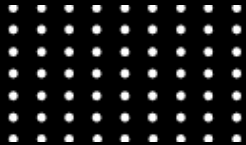


# All beginning with YOUR



***Java Virtual Machine  
Code Guidelines  
Architecture  
Web Frontend***

# *Java Virtual Machine*





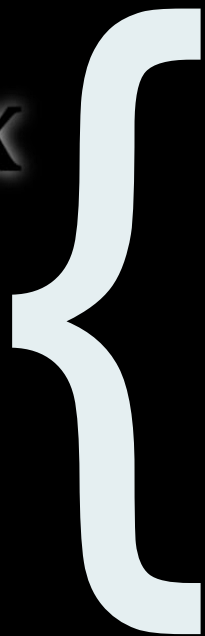
# Measuring the energy (JIT / AOT)



Linux

ubuntu<sup>®</sup>

PERF RAPL



azul

Prime VM

GraalVM<sup>™</sup>

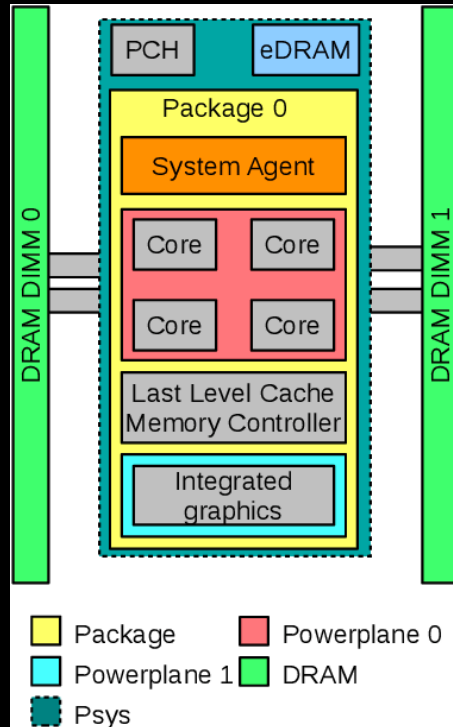
Oracle  
CE  
Native Image

OpenJDK

OpenJ9

# How to measure energy consumption

link: [\[article\]](#)



$$\text{Energy} = \text{energy-pkg} + \text{energy-ram}$$

(Joules or Watt sec)







# Spring PetClinic

link: [\[article\]](#)





# QUARKUS





# Quarkus Hibernate ORM Panache

link: [\[article\]](#)



# A modern benchmark suite for the JVM

Documentation 

GitHub Repo 



 Download latest



Main

passing

## Renaissance Suite

Renaissance is a **modern**, **open**, and **diversified** benchmark suite for the JVM, aimed at testing JIT compilers, garbage collectors, profilers, analyzers and other tools.



# Renaissance

link: [\[article\]](#)

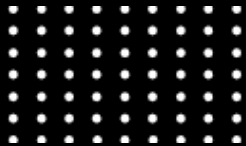


# Most eco friendly JVM



## In our case

# ***Code Guidelines***





  
Greenit-  
Analysis-cli  
based on  
Ecometer  
rules



  
Google  
Lighthouse



  
W3C  
Validator

## ECOSONAR API

A standalone API that will run audits on your website pages.

EcoSonar worked as an audit aggregator to run dynamic analysis of your code (how your page will be rendered within a browser).



  
sonarqube

## ECOSONAR PLUGIN

A Sonarqube plugin to include EcoSonar audits into your Sonarqube project and launch automatically EcoSonar analysis once a Sonarqube analysis is triggered.



## ECOCODE PLUGINS

Sonarqube plugins to audit code.



EcoSonar

# EcoSonar



## Rules

---

Avoid getting the size of the collection in the loop

Avoid multiple if-else statement

Avoid Spring repository call in loop

Avoid SQL request in loop

Avoid the use of Foreach with Arrays

Avoid usage of static collections.

Avoid using global variables

Avoid using Pattern.compile() in a non-static context.

Do not call a function when declaring a for-type loop

Do not unnecessarily assign values to variables

Don't concatenate Strings in loop, use StringBuilder instead.

Don't set const parameter in batch update => Put its in query

Don't use the query SELECT \* FROM

Free resources

Initialize builder/buffer with the appropriate size

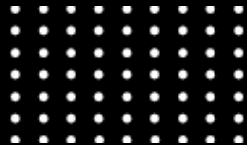
Optimize read file exceptions

Use ++i instead of i++

Use PreparedStatement instead of Statement

Use System.arraycopy to copy arrays

*Use it in your pipeline!*



# Patterns



Memory Access Patterns

Logging Patterns

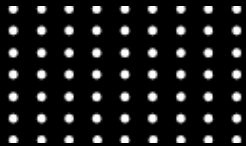
Throwing Exception Patterns





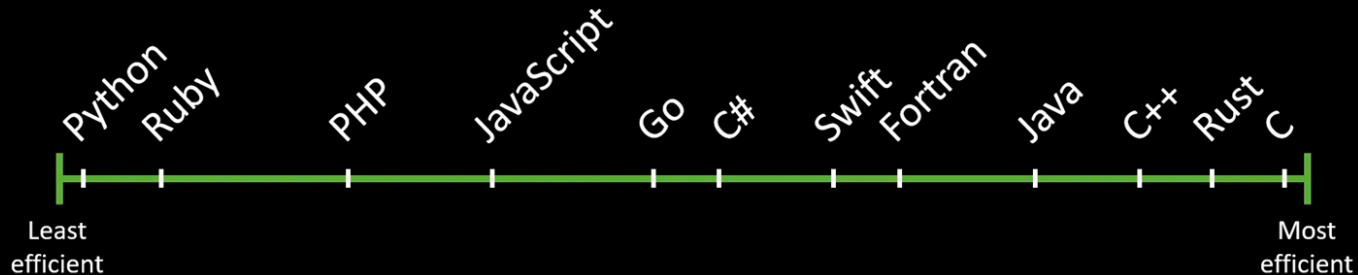
***You have to measure on your  
specific use case***

# *Architecture*



# Java is an eco friendly language

Energy efficiency of programming languages



<https://kaspergroesludvigsen.medium.com/the-10-most-energy-efficient-programming-languages-6a4165126670>

<https://greenlab.di.uminho.pt/wp-content/uploads/2017/09/paperSLE.pdf>

# *Performance (Maven caching example)*





# Adjust your pom.xml



```
<build>
  <extensions>
    <extension>
      <groupId>org.apache.maven.extensions</groupId>
      <artifactId>maven-build-cache-extension</artifactId>
      <version>1.0.0</version>
    </extension>
  </extensions>
</build>
```

and in your pipeline ->



# Autoscaling



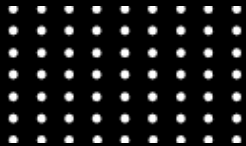
*By YML (Kubernetes)*  
link: [\[article\]](#)



*By YML or GUI (CF)*  
link: [\[article\]](#)

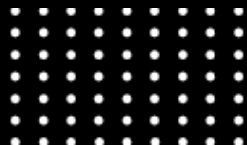


# ***Web Frontend***





*goto*  
*websitecarbon.com*







Uh oh! This web page is dirtier  
than **98%** of web pages  
tested



Oh my, **4.96g of CO<sub>2</sub>** is produced every  
time someone visits this web page.

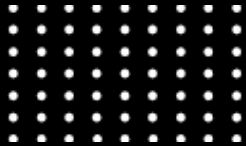


Oh no, it looks like this web page uses  
**bog standard energy**

← If this site used green hosting, then it  
would emit 9% less CO<sub>2</sub>



*goto*  
*thegreenwebfoundation.org*



# Improvements

**Images -> less is more, downsize, no carousels**

**Video's -> avoid, or use links (embedded)**

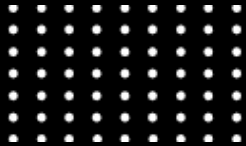
**Content -> minify your HTML, no unused code**

**Downloads -> compress your data, optimize cookies**

**Coding -> avoid network calls**



***So what to remember after  
this talk?***



# Key Takeaways



- 1. Choose the “appropriate” JVM***
- 2. Implement EcoSonar***
  - 1. Pipeline enhancements like caching***
  - 1. Measure with Carbon Calculator***



slides

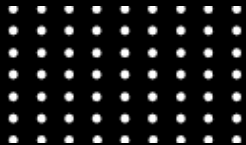


github

*Thank you and*  
**GO GREEN!**

Please feel free to reach out to us if you want to contribute  
[github.com/ionutbalosin/jvm-energy-consumption](https://github.com/ionutbalosin/jvm-energy-consumption)

# *Other tips*





**Ronald Dehuysser** @rdehuyss · 17 jun.

Part of the revenue I make with [@JobRunr](#) goes to [@teamtreesofficial](#) - because as I think that the boyscout rule is applicable everywhere, also in the real world.

# LEADERBOARD

SEARCH 

MOST RECENT

MOST TREES



JOB RUNR

**JobRunr**

New license, new trees!

225 trees

17/06/2023, 11:51:06



JOB RUNR

**JobRunr**

New license, new trees!

75 trees

17/06/2023, 11:48:56



## THE FOREST OF Ko Turk

### 1 Select a plantation project

Where would you like to plant your trees?



Project:	Reforestation and Conservation
Species:	Quercus robur
Trees per recipient:	1
Number of recipients:	1
Trees to plant:	1
Total CO2 offset:	140 Kg
Total price:	2,50 €

Plant your trees

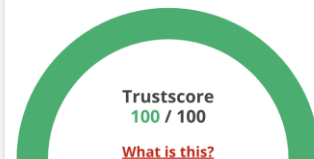
 Learn how to offer trees

Credits in your account:

0 € 

### 2 Choose one species

This is a short list of species we selected for you. Pick one species or select a project in the section above.



[What is this?](#)

[Disclaimer](#)







# Books

