Étiquette-énergie logicielle

Mythe ou réalité ?

Olivier Le Goaër © 2025

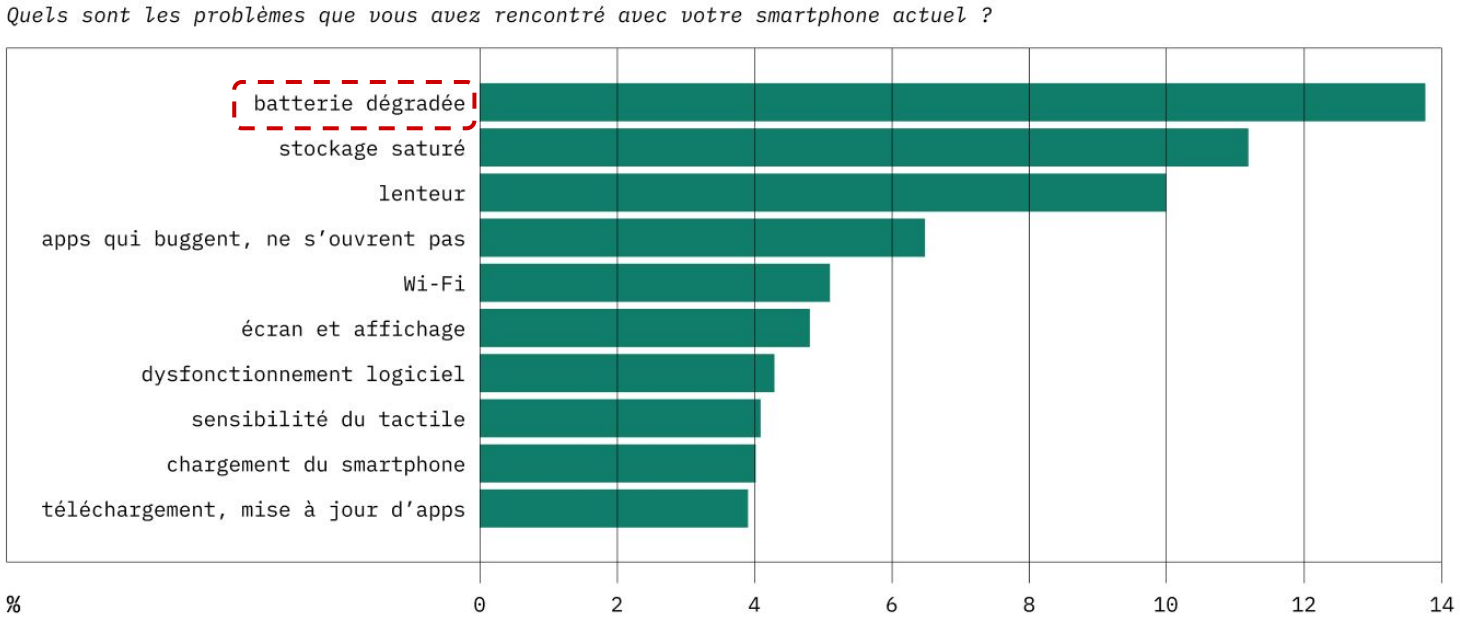
cnrs GDR Groupement de recherche GPL Génie de la programmation et du logiciel

Université de Pau et des Pays de l'Adour

GREEN CODE INITIATIVE

Sondage sur l'obsolescence des smartphones

42% des problèmes sont d'ordre logiciel pur



enquête menée en 2023 sur un échantillon représentatif de 1 000 français (source)

Le chaînon manquant…en 2025

Hard-ware

Comprendre l'étiquette énergétique des smartphones et des tablettes

1. Échelle des classes d'efficacité énergétique de A à G.
2. La classe d'efficacité énergétique de ce produit.
3. L'endurance de la batterie par cycle, en heures et en minutes par charge complète de la batterie.
4. Classe de fiabilité répétée de la chute libre.
5. Endurance de la batterie dans les cycles.
6. Classe de réparabilité.
7. Indice de protection contre l'entrée.

European Commission

EPREL
(European Product Registry Energy Labelling)

Soft-ware

???

La promesse d'un "éco-score" logiciel

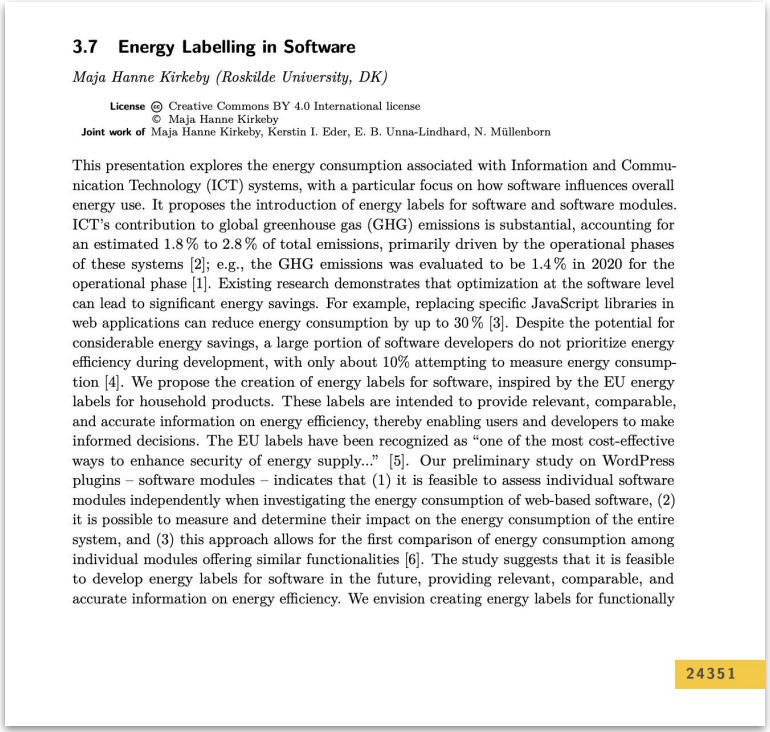
Logiciel en **phase d'usage**

Dagstuhl Seminar 24351

Power, Energy, and Carbon-Aware Computing on Heterogeneous Systems (PEACHES)

Aug 25 – Aug 30, 2024

https://www.dagstuhl.de/en/seminars/seminar-calendar/seminar-details/24351



3.7 Energy Labelling in Software

Maja Hanne Kirkeby (Roskilde University, DK)

This presentation explores the energy consumption associated with Information and Communication Technology (ICT) systems, with a particular focus on how software influences overall energy use. It proposes the introduction of energy labels for software and software modules. ICT's contribution to global greenhouse gas (GHG) emissions is substantial, accounting for an estimated 1.8 % to 2.8 % of total emissions, primarily driven by the operational phases of these systems [2]; e.g., the GHG emissions was evaluated to be 1.4 % in 2020 for the operational phase [1]. Existing research demonstrates that optimization at the software level can lead to significant energy savings. For example, replacing specific JavaScript libraries in web applications can reduce energy consumption by up to 30 % [3]. Despite the potential for considerable energy savings, a large portion of software developers do not prioritize energy efficiency during development, with only about 10% attempting to measure energy consumption [4]. We propose the creation of energy labels for software, inspired by the EU energy labels for household products. These labels are intended to provide relevant, comparable, and accurate information on energy efficiency, thereby enabling users and developers to make informed decisions. The EU labels have been recognized as "one of the most cost-effective ways to enhance security of energy supply..." [5]. Our preliminary study on WordPress plugins – software modules – indicates that (1) it is feasible to assess individual software modules independently when investigating the energy consumption of web-based software, (2) it is possible to measure and determine their impact on the energy consumption of the entire system, and (3) this approach allows for the first comparison of energy consumption among individual modules offering similar functionalities [6]. The study suggests that it is feasible to develop energy labels for software in the future, providing relevant, comparable, and accurate information on energy efficiency. We envision creating energy labels for functionally

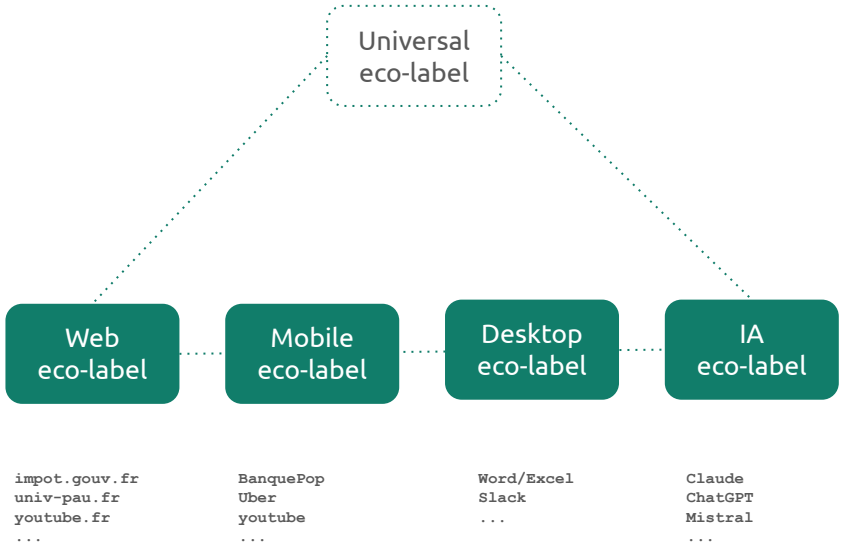
Parties prenantes

Un eco-label pour les gouverner tous ?

Abandonner l'idée d'un éco-score universel

Il faut raisonner en typologie applicative, et peut-être même en fonctionnalité (jeux vidéos versus le reste)

Autant de méthodes de diagnostic, et autant de scores/étiquettes



Diagnostic de Performance Énergétique Logiciel (DPE-L)

Défi #1 : calculer l'étiquette

Wattmètres 100% logiciel

Mesure d'énergie (Joules)

“*choose the right tool for the job*”

Banc de mesure

Baseline + scenario répété un grand nombre de fois

Plateformes cibles réelles ou émulées

Norme/protocole de mesure

ISO/IEC/IEEE 15939:2017 (Systems and software engineering — Measurement process)

PowerAPI

PowerJoular

CODE CARBON

JoularX

PowDroid

Alumet

Les limites de la mesure logicielle

Périmètre fonctionnel **flou**

+

Pas de scénario d'usage **nominal**

+

Environnement d'exécution **non contrôlé**

+

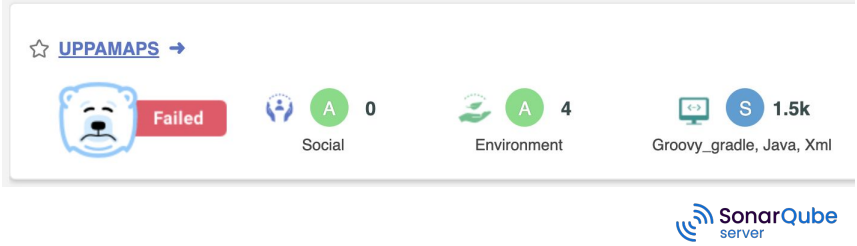
Système logiciel **distribué**

Coup d'œil au DPE immobilier (2025)

“Le diagnostic de performance énergétique (DPE), qui classe les logements de A à G en fonction de leur consommation d'énergie et de leur impact sur le climat, est obligatoire dans les logements destinés à être habités. **Il ne se base plus sur les factures d'énergie**, mais sur les **caractéristiques du bâtiment** (qualité de l'isolation, type de fenêtres, système de chauffage…)”

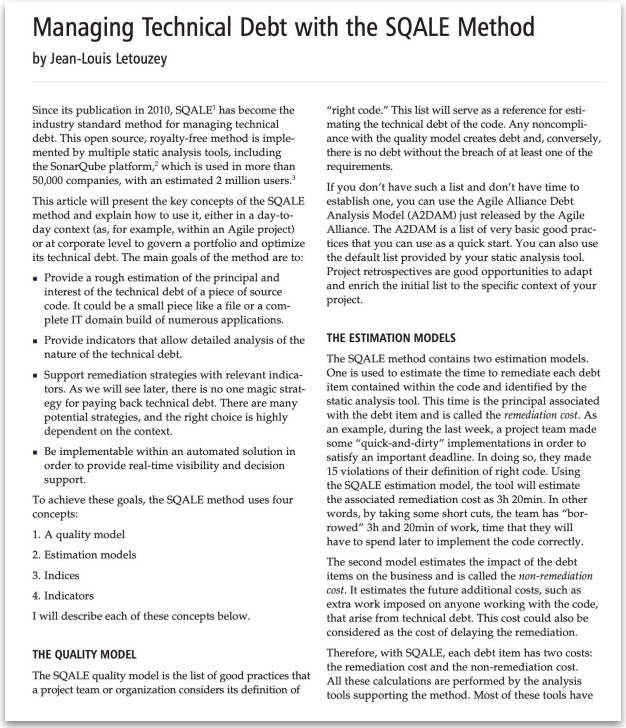
💡 La **mesure** (en kWh/an) est abandonnée au profit d’**indicateurs observables en surface**

Dette technique sur le volet *Sustainability*



`sqale_debt_ratio` = technical debt /(cost to develop one line of code * number of lines of code)

The technical debt is the sum of the sustainability issue remediation costs. An issue remediation cost is the effort (in minutes) evaluated to fix the issue.



Managing Technical Debt with the SQALE Method

by Jean-Louis Letouzey

Since its publication in 2010, SQALE[1] has become the industry standard method for managing technical debt. This open source, royalty-free method is implemented by multiple static analysis tools, including the SonarQube platform,[2] which is used in more than 50,000 companies, with an estimated 2 million users.[3]

This article will present the key concepts of the SQALE method and explain how to use it, either in a day-to-day context (as, for example, within an Agile project) or at corporate level to govern a portfolio and optimize its technical debt. The main goals of the method are to:

- Provide a rough estimation of the principal and interest of the technical debt of a piece of source code. It could be a small piece like a file or a complete IT domain build of numerous applications.
- Provide indicators that allow detailed analysis of the nature of the technical debt.
- Support remediation strategies with relevant indicators. As we will see later, there is no one magic strategy for paying back technical debt. There are many potential strategies, and the right choice is highly dependent on the context.
- Be implementable within an automated solution in order to provide real-time visibility and decision support.

To achieve these goals, the SQALE method uses four concepts:

1. A quality model
2. Estimation models
3. Indices
4. Indicators

I will describe each of these concepts below.

THE QUALITY MODEL

The SQALE quality model is the list of good practices that a project team or organization considers its definition of "right code." This list will serve as a reference for estimating the technical debt of the code. Any noncompliance with the quality model creates debt and, conversely, there is no debt without the breach of at least one of the requirements.

If you don't have such a list and don't have time to establish one, you can use the Agile Alliance Debt Analysis Model (A2DAM) just released by the Agile Alliance. The A2DAM is a list of very basic good practices that you can use as a quick start. You can also use the default list provided by your static analysis tool. Project retrospectives are good opportunities to adapt and enrich the initial list to the specific context of your project.

THE ESTIMATION MODELS

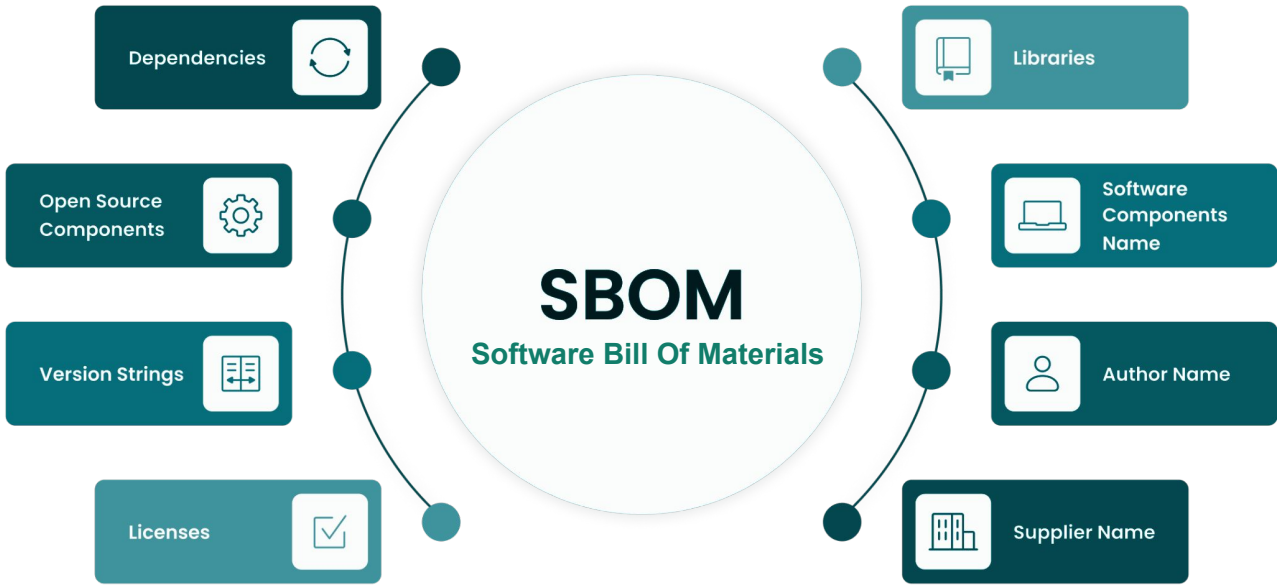
The SQALE method contains two estimation models. One is used to estimate the time to remediate each debt item contained within the code and identified by the static analysis tool. This time is the principal associated with the debt item and is called the *remediation cost*. As an example, during the last week, a project team made some "quick-and-dirty" implementations in order to satisfy an important deadline. In doing so, they made 15 violations of their definition of right code. Using the SQALE estimation model, the tool will estimate the associated remediation cost as 3h 20min. In other words, by taking some short cuts, the team has "borrowed" 3h and 20min of work, time that they will have to spend later to implement the code correctly.

The second model estimates the impact of the debt items on the business and is called the *non-remediation cost*. It estimates the future additional costs, such as extra work imposed on anyone working with the code, that arise from technical debt. This cost could also be considered as the cost of delaying the remediation.

Therefore, with SQALE, each debt item has two costs: the remediation cost and the non-remediation cost. All these calculations are performed by the analysis tools supporting the method. Most of these tools have

SBOM sur le volet *Sustainability*

Étudier la “composition” d’un logiciel pour en déduire sa note (A à E)



Biais des *-score

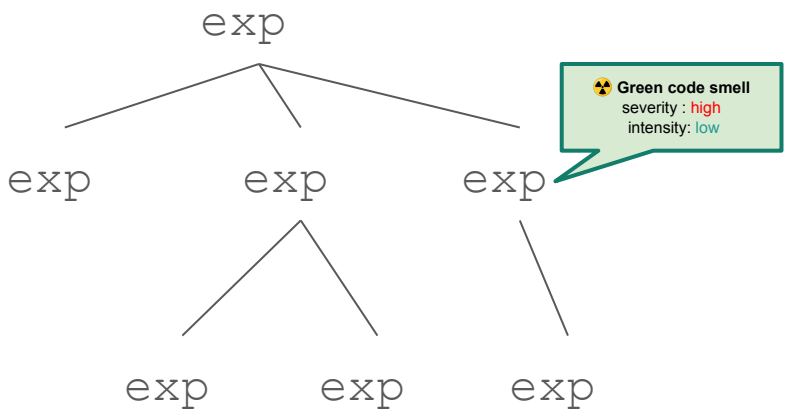
“Malgré l’adaptation de Nutri-Score pour la catégorie des produits laitiers, près de 90 % des fromages se retrouvent classés en D ou E (80 % en D)”

… sauf qu’on en mange qu’une petite portion en fin de repas 🧀

🤔 Pour savoir ce qui est réellement **mauvais pour la santé**, il faut regarder **2 facettes** : composition + ingestion

Vers un DPE-L hybride

Pour savoir ce qui est « mauvais » pour la santé de la batterie, il faut en réalité regarder 2 facettes : analyse statique + analyse dynamique



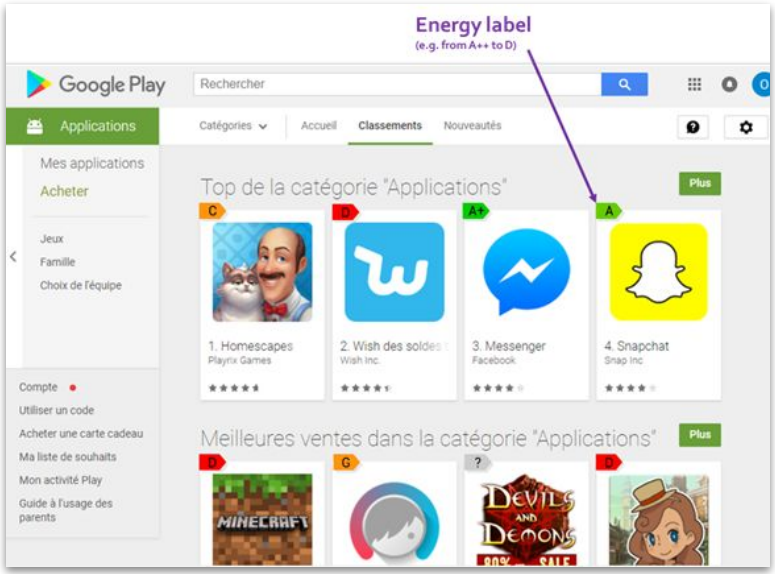
ABSTRACT SYNTAX TREE

Affichage environnemental

Défi #2 : publier l’étiquette

Registres centralisés

Magasins applicatifs



Site gouvernemental (annuaire)

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

mi num_ eco

Mission interministérielle
Numérique écoresponsable

https://ecoresponsable.numerique.gouv.fr/scores/

Imiter les *Scorecard Badges*

https://api.scorecard.dev/projects/github.com/{owner}/{repo}/badge

Registre décentralisé : "*ecoChain*"

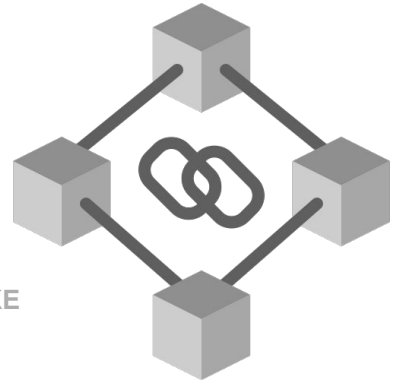
DPE-L

Nom du Logiciel
Numéro de Version
Date de Publication
Hash du Fichier
Auteurs/Contributeurs
Licence (Hash)
eco-score (A à E)

data

Transaction

registered in



PROOF-OF-STAKE
BLOCKCHAIN

Merci

Des idées ?
Des questions ?

présentation | vidéo

présentation | vidéo