

Supplementary Material (SLR on Sustainability of Software)

Supplementary material for the article

Measuring Code Level Determinants of Software Sustainability: A Systematic Literature Review

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This online resource accompanies the article and provides the complete list of the 137 studies included in the systematic literature review. Table S1 reports, for each study, its identifier, short title, publication year, publication type, retrieval source, and quality assessment (QAS) tier. Studies ID1 to ID58 were retrieved through the nine database driven search and studies SB-001 to SB-079 through backward and forward snowballing. The same identifiers are used throughout the article. The full bibliographic references of all 137 studies are listed at the end of this document, ordered alphabetically by first author, consistent with the reference style of the article.

Table S1: Complete list of the 137 studies included in the review.

ID	Title	Year	Type	Source	QAS
ID1	Sustainable Software Engineering: Concepts, Challenges, and Vision	2025	Journal	ACM	Low
ID2	Energy Codesumption: Test Execution for Source Code Energy Analysis	2025	Conference	ACM	Low
ID3	Unveiling the Energy Vampires: Debugging Software Energy Consumption	2025	Conference	ACM	Medium
ID4	Energy Consumption of Automated Program Repair	2024	Conference	ACM	Low
ID5	Knowledge Base of Common Sustainability Weaknesses in Green Software Development	2024	Conference	ACM	Medium
ID6	Software Industry Awareness on Green and Sustainable Software Engineering	2019	Conference	ACM	Medium
ID7	Twins or False Friends? Energy and Performance of Configurable Software	2023	Conference	ACM	High
ID8	Green Software Development with the HADAS Toolkit	2017	Conference	ACM	High
ID9	SensorLib: Energy-Efficient Sensor-Collection Library for Wear OS	2024	Conference	ACM	High
ID10	Advancing Carbon-Efficient Software Development	2025	Conference	ACM	High

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ID	Title	Year	Type	Source	QAS
ID11	Carbon Footprint of Manual vs. LLM-Assisted Code Development	2025	Conference	ACM	High
ID12	The Sustainability Face of Automated Program Repair Tools	2025	Journal	ACM	High
ID13	GAISSALabel: Energy Labeling of ML Models	2024	Conference	ACM	High
ID14	Towards Greener Android Application Development	2020	Conference	ACM	High
ID15	Energy Efficiency of ROS Nodes in Different Languages	2024	Conference	ACM	High
ID16	RMVRVM: Energy Efficient User Applications via REST API	2022	Conference	ACM	High
ID17	ESAVE: Estimating Server and Virtual Machine Energy	2023	Conference	ACM	High
ID18	Trading Runtime for Energy Efficiency: Power Caps across Languages	2024	Conference	ACM	High
ID19	Calm Energy Accounting for Multithreaded Java Applications	2020	Conference	ACM	High
ID20	Energy Efficiency Across Programming Languages	2017	Conference	ACM	High
ID21	SusDevOps: Sustainability as a First Principle in Software Delivery	2025	Conference	ACM	Medium
ID22	Towards a Catalog of Energy Patterns in Deep Learning Development	2022	Conference	ACM	High
ID23	Practitioners' Perspectives on Green Software Engineering	2016	Conference	ACM	High
ID24	Hybrid GPU/CPU/RAM Power Model for Multimedia Workloads	2016	Conference	ACM	High
ID25	ML-Driven Dynamic Optimisation for Energy-Efficient Execution	2025	Conference	ACM	High
ID26	Practices of Energy Consumption for Sustainable Software Engineering	2018	Conference	ACM	High
ID27	Energy-Efficient Programming Languages for Mobile Applications	2021	Conference	Google Scholar	Medium
ID28	The Dimension of Green Coding in Software Quality Control	2024	Conference	Google Scholar	Medium
ID29	Static/Dynamic Analysis of Android Applications for Energy Efficiency	2022	Conference	IEEE	Low
ID30	OS Energy Consumption Measurement with Energy Efficiency Approach	2023	Research report	IEEE	Medium
ID31	Challenges in Green Sustainable Software for Multisourcing Vendors	2018	Conference	IEEE	High
ID32	Energy Estimation and Power Modeling for Smartphone Applications	2016	Conference	IEEE	Medium
ID33	Green Cybersecurity: Antivirus Energy Consumption Evaluation	2025	Conference	Google Scholar	Low

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ID	Title	Year	Type	Source	QAS
ID34	Demeter: Long-Term Monitoring of Software Power Consumption	2024	Conference	Google Scholar	Medium
ID35	Tactics for Software Energy Efficiency: A Review	2024	Conference	Google Scholar	High
ID36	Meta-Analytical Comparison of Energy Consumed by Two Languages	2021	Conference	Google Scholar	High
ID37	Programming Languages' Impact on Energy for Sorting Algorithms	2019	Conference	Google Scholar	Medium
ID38	Green Software Requirements: Random Decision Forests Energy Profiling	2015	Journal	Google Scholar	Medium
ID39	Enhanced Energy Efficiency with the Actor Model	2016	Conference	Google Scholar	Medium
ID40	GreenC5: Adaptive Energy-Aware Collection for Green Software	2017	Research Article	Springer Link	High
ID41	Estimating Mobile Software Energy Consumption: A Review	2024	Research Article	Springer Link	High
ID42	Test Smell: A Parasitic Energy Consumer in Software Testing	2025	Research Article	Springer Link	High
ID43	SPELLing Out Energy Leaks: Locating Inefficient Code	2020	Research Article	Springer Link	High
ID44	Two Best Practices for Energy-Efficient Software Development	2016	Research Article	Springer Link	High
ID45	Comprehensive Survey on Energy-Efficient Power Management	2020	Research Article	Science Direct	Low
ID46	Energy Optimisation in Sorting Techniques: A Comparative Study	2024	Article	Science Direct	High
ID47	Paint Your Programs Green: Energy Efficiency of Data Structures	2023	Conference	Science Direct	Medium
ID48	Android-Specific Code Smells and Energy Bugs Detection	2020	Conference	Science Direct	Medium
ID49	Computational Thinking to Improve Energy-Efficient Programming	2018	Conference	Science Direct	Medium
ID50	Refactorings for Energy-Efficiency	2016	Proceedings Paper	Science Direct	High
ID51	The Impact of Source Code on Power Consumption	2016	Journal	Wiley	High
ID52	Greening the Web: Front-End Optimisation for Energy and Carbon	2021	Journal	Wiley	Low
ID53	Automated Code Optimizer of Design Patterns for Energy	2018	Journal	Wiley	High
ID54	Code Refactoring for Energy-Saving Distributed Systems	2024	Journal	Scopus	High
ID55	Estimating Energy Consumption of MVC Applications	2023	Journal	Scopus	High
ID56	Energy Efficiency of Mobile Apps on Android and iOS Platforms	2025	Conference	Scopus	High

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ID	Title	Year	Type	Source	QAS
ID57	Detecting Energy Bugs and Hotspots in Control Software	2018	Conference	Scopus	High
ID58	ML Model Selection and Its Impact on Sustainability	2025	Conference	Web of Science	High
SB-001	Energy Profiles of Java Collections Classes	2016	Conference	Snowballing	High
SB-002	SDLC for Energy Efficiency: Techniques and Tools	2019	Journal	Snowballing	High
SB-003	Awakening Awareness on Energy Consumption in Software Engineering	2017	Conference	Snowballing	Medium
SB-004	Energy Consumption of Android App Development Approaches	2017	Conference	Snowballing	High
SB-005	Ranking Programming Languages by Energy Efficiency	2021	Journal	Snowballing	High
SB-006	Does Maintainability Relate to the Energy Consumption of Software?	2021	Journal	Snowballing	Medium
SB-007	E-Debitum: Managing Software Energy Debt	2020	Conference	Snowballing	Medium
SB-008	How Does Code Obfuscation Impact Energy Usage?	2016	Journal	Snowballing	Medium
SB-009	Detecting Display Energy Hotspots in Android Apps	2015	Conference	Snowballing	Medium
SB-010	Data-Oriented Characterisation of Application-Level Energy Optimisation	2015	Conference	Snowballing	High
SB-011	Haskell in Green Land: Energy Behavior of a Functional Language	2016	Conference	Snowballing	Medium
SB-012	GreenOracle: Estimating Software Energy with Measurement Corpora	2016	Conference	Snowballing	Medium
SB-013	Greenup, Powerup, Speedup Metrics for Energy Efficiency	2015	Conference	Snowballing	Medium
SB-014	Helping Programmers Improve Energy Efficiency of Source Code	2017	Conference	Snowballing	Medium
SB-015	Empirical Evaluation of Energy Impact of Refactoring Code Smells	2018	Conference	Snowballing	High
SB-016	Android Developers and the Energy Consumption of ML	2019	Journal	Snowballing	High
SB-017	jStanley: A Green Thumb on Java Collections	2018	Conference	Snowballing	High
SB-018	Multi-Objective Optimisation of Energy of GUIs in Android Apps	2018	Journal	Snowballing	High
SB-019	PortAuthority: Energy Efficiency in Cross-Platform Development	2021	Journal	Snowballing	High
SB-020	Improving Energy-Efficiency by Recommending Java Collections	2021	Journal	Snowballing	High
SB-021	Mining API Interactions for Evolution of Energy Consumption	2021	Conference	Snowballing	Medium

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ID	Title	Year	Type	Source	QAS
SB-022	Green Software Requirements: Energy Profiling (Journal version)	2017	Journal	Snowballing	High
SB-023	Power Efficient Algorithms and Carbon Emissions in Cloud Data Centers	2015	Journal	Snowballing	Medium
SB-024	POSE: A Visual Modelling Tool for Energy Aware Optimisation	2015	Conference	Snowballing	Medium
SB-025	Reducing Energy Consumption Using Genetic Improvement	2015	Conference	Snowballing	Medium
SB-026	Monitoring Energy Hotspots in Software	2015	Journal	Snowballing	Medium
SB-027	Model-Based Energy Efficiency Analysis of Software Architectures	2015	Conference	Snowballing	High
SB-028	Application-Level Energy Awareness for OpenMP	2015	Conference	Snowballing	Medium
SB-029	Client-Side Energy Efficiency of HTTP/2 for Web and Mobile	2016	Conference	Snowballing	Medium
SB-030	Energy-Aware Test-Suite Minimisation for Android Apps	2016	Conference	Snowballing	High
SB-031	Impact of Code Smells on Energy Consumption of Mobile Apps	2019	Journal	Snowballing	High
SB-032	Green Database Design Model in SDLC Phase	2016	Journal	Snowballing	Low
SB-033	Energy Efficiency of ORM Approaches: An Empirical Evaluation	2016	Conference	Snowballing	Medium
SB-034	Predicting Data Structures for Energy Efficient Computing	2015	Conference	Snowballing	High
SB-035	Energy Efficiency of IoT Software Architecture with Reusable Components	2017	Journal	Snowballing	High
SB-036	Investigating the Energy Impact of Android Smells	2017	Conference	Snowballing	Medium
SB-037	Code Smell Elimination Sequences for Energy Efficient Software	2016	Conference	Snowballing	Medium
SB-038	EnergyPatch: Repairing Resource Leaks for Energy-Efficiency	2018	Journal	Snowballing	High
SB-039	Assisting Non-Specialist Developers to Build Energy-Efficient Software	2017	Conference	Snowballing	Medium
SB-040	E-Android: New Energy Profiling Tool for Smartphones	2017	Conference	Snowballing	Medium
SB-041	μ Droid: Energy-Aware Mutation Testing for Android	2017	Conference	Snowballing	High
SB-042	Energy Impact of Logging on Android Applications	2018	Journal	Snowballing	High
SB-043	Relating Software Structure with Energy Consumption	2017	Conference	Snowballing	Medium
SB-044	Building Secure Energy-Efficient Android Applications	2018	Journal	Snowballing	High

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ID	Title	Year	Type	Source	QAS
SB-045	Self-Adaptive Energy-Efficient Applications: The HADAS Approach	2017	Conference	Snowballing	Medium
SB-046	Code-Analysis-Based Energy Estimation Framework	2019	Journal	Snowballing	High
SB-047	Features Affecting Energy Consumption of Web Servers	2018	Journal	Snowballing	High
SB-048	Remove RATs from Your Code: Optimisation for Mobile Apps	2018	Conference	Snowballing	High
SB-049	GreenScaler: Training Energy Models with Automatic Test Generation	2019	Journal	Snowballing	High
SB-050	Programming Language’s Energy-Delay Implications	2018	Conference	Snowballing	Medium
SB-051	Energy of HTTP POST Request Methods for Android Apps	2018	Conference	Snowballing	Medium
SB-052	Minimisation of Energy in Smart Phone Application Development	2018	Journal	Snowballing	Medium
SB-053	On Haskell and Energy Efficiency	2019	Journal	Snowballing	High
SB-054	Feedback on Energy Tests for Proposed Code Changes	2019	Journal	Snowballing	Medium
SB-055	Investigating Power Efficiency of Mergesort	2019	Journal	Snowballing	High
SB-056	GreenBundle: Energy Impact of Bundled Processing	2019	Conference	Snowballing	High
SB-057	Search-Based Energy Testing of Android	2019	Conference	Snowballing	Medium
SB-058	GreenSource: Large-Scale Android Code, Tests and Energy Metrics	2019	Conference	Snowballing	Medium
SB-059	Catalog of Energy Patterns for Mobile Applications	2019	Journal	Snowballing	Medium
SB-060	ServDroid: Service Usage Inefficiencies in Android Apps	2019	Conference	Snowballing	High
SB-061	Comprehending Energy Behaviors of Java I/O APIs	2019	Conference	Snowballing	High
SB-062	Analysis of Energy Consumption and Optimisation for Energy-Efficient Code	2019	Journal	Snowballing	High
SB-063	Code Smell Refactoring Impact on Energy of Android Apps	2019	Conference	Snowballing	High
SB-064	Do Energy-Oriented Changes Hinder Maintainability?	2019	Conference	Snowballing	High
SB-065	Proactive and Adaptive Energy-Aware Programming	2017	Conference	Snowballing	High
SB-066	Energy Refactorings for Android in the Large and in the Wild	2020	Conference	Snowballing	High

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ID	Title	Year	Type	Source	QAS
SB-067	Reducing Energy Consumption of Software: From Hurdles to Requirements	2020	Conference	Snowballing	Medium
SB-068	Programming Languages' Impact on Energy for Mobile Devices	2020	Conference	Snowballing	Medium
SB-069	Automated Construction of Energy Test Oracles for Android	2020	Conference	Snowballing	High
SB-070	Annotating Executable DSLs with Energy Estimation Formulas	2020	Conference	Snowballing	Medium
SB-071	FEETINGS: Framework for Energy Efficiency Testing	2021	Journal	Snowballing	High
SB-072	Impact of Java Virtual Machines on Energy Consumption	2021	Conference	Snowballing	High
SB-073	Execution Time and Energy of Developing with Spring	2021	Journal	Snowballing	High
SB-074	Green Mining: Software Change and Configuration vs Power	2015	Journal	Snowballing	High
SB-075	Runtime Verification of Expected Energy Consumption in Smartphones	2015	Conference	Snowballing	High
SB-076	Energy Consumption Analysis of Programs Based on X MOS ISA-Level Models	2017	Conference	Snowballing	Medium
SB-077	Dynamic Analysis Based Energy Estimation Tools Assessment	2018	Conference	Snowballing	Medium
SB-078	Code Refactoring Techniques Impact on Energy in OOP Languages	2019	Conference	Snowballing	Medium
SB-079	Deep Learning-Based Software Energy Consumption Profiling	2019	Conference	Snowballing	Medium

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