

Expression of Interest (EoI)

MSCA Postdoctoral Fellowships 2026

Host Institution: University of L'Aquila, Italy — Department of Engineering, Computer Science and Mathematics, Software Engineering Group, FrAmeLab laboratory

Project

Autonomous Agentic Framework for Sustainable Software Synthesis.

Hosting Information: University of L'Aquila (UnivAQ), Italy

Offer Deadline: July 10th, 2026

EU Research Framework: Horizon Europe - MSCA Postdoctoral Fellowships 2026

Country: Italy

City: L'Aquila

Organisation/Institute

Organisation: Software Engineering Research Group, University of L'Aquila, Italy

Department: DISIM - Department of Engineering, Computer Science and Mathematics.

Contact Information

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Description

Project Title: Autonomous Agentic Framework for Sustainable Software Synthesis

Research Context & Motivation

The rapid proliferation of Large Language Models (LLMs) has revolutionized software development, yet it has introduced a “sustainability paradox” within the European Union’s **Twin Transition** (Green and Digital). While digital transformation accelerates economic growth, the computational cost of generating and executing AI-written code often ignores environmental externalities. Current code generation benchmarks focus almost exclusively on functional correctness (e.g., HumanEval), neglecting the energy footprint of the resulting software. Research suggests that inefficient code can increase energy consumption by up to 50% for the same task.

This research is urgently needed to align AI development with the **European Green Deal**, which aims for climate neutrality by 2050, and the **Circular Economy Action Plan**, which emphasizes “green-by-design” digital products. As data centers consume an increasing share of global electricity, moving from “functional” to “green” code generation is a strategic priority for EU digital sovereignty. By utilizing **Agentic Systems**—where autonomous agents can

iteratively profile, critique, and refactor code for efficiency—this project addresses the hidden carbon cost of the software lifecycle. This aligns with the **EU’s 2030 Digital Compass**, ensuring that technological leadership does not come at the cost of environmental degradation.

Goal & Objectives

The primary ambition of this project is to develop the first **Autonomous Agentic Framework for Sustainable Software Synthesis**. Unlike traditional generators that produce code in a single pass, this framework will employ a multi-agent “Green-Refactor” loop, where specialized agents collaborate to balance algorithmic performance with minimal energy consumption.

The specific scientific objectives are:

1. **Design an Energy-Aware Agentic Architecture:** Develop a multi-agent system consisting of a *Generator*, a *Hardware-in-the-Loop Profiler*, and a *Green Critic*. The goal is to move beyond static analysis to dynamic energy-efficiency feedback.
2. **Establish “Green-by-Design” Reward Functions:** Create novel Reinforcement Learning from AI Feedback (RLAIF) mechanisms that penalize computationally expensive patterns (e.g., redundant loops, inefficient memory allocation) without sacrificing 100% functional accuracy.
3. **Achieve a 25% Reduction in Execution Energy:** Demonstrate that code produced by this agentic framework consumes significantly less energy across standard benchmarks (e.g., BigCodeBench) compared to baseline models like GPT-4o or Llama-3, specifically targeting data-intensive Python and C++ environments.

By achieving these objectives, the fellowship will provide a scalable methodology for the industry to adopt sustainable coding practices, directly contributing to the **EU’s Zero Pollution Action Plan**.

Research Method

This project adopts an **interdisciplinary, experimental approach** combining Software Engineering, Autonomous Agents, and Environmental Science. The methodology is structured in three phases:

- **Phase 1: Instrumentation and Benchmarking.** We will utilize high-fidelity energy profiling tools such as **CodeCarbon** and **PowerAPI** to create a baseline of energy consumption for common algorithmic tasks. We will integrate physical power meters for “Hardware-in-the-Loop” validation to ensure software-reported metrics reflect true physical consumption.
- **Phase 2: Agentic Framework Development.** Using an orchestration layer (e.g., LangGraph or AutoGen), we will implement the “Green-Refactor” loop. The *Generator agent* will draft code, while the *Profiler agent* executes it in a containerized environment to measure energy joules per execution. The *Critic agent* will then suggest refactoring strategies based on the **Green Software Foundation’s** principles.
- **Phase 3: Validation and Comparative Analysis.** We will conduct a large-scale computational experiment comparing our agentic system against state-of-the-art non-green models.

In line with **Open Science** practices, all codebases, the specialized “Green-Prompt” library, and the resulting energy-annotated dataset will be made available via **Zenodo** and **GitHub**. This ensures reproducibility and allows the wider EU research community to build upon our framework.

Technology & Infrastructure

The fellow will have full access to:

- The FrAmeLab and UnivAq equipment (workstations, Caliban High-Performance Computing Cluster)
- ACM/IEEE library archives
- Office space within the Information Engineering, Computer Science, and Mathematics Department (DISM).

Expected Output

As per our team policy, we will work together to publish on top journals (such as IEEE TSE, ACM TOSEM, JSS, IST) and in top conferences (such as ICSE, ICSA, ECSA, FSE, ASE, MODELS). The MSCA fellow will work in collaboration with the FrAmeLab team members. He/She will be mentioned as the first author in all those publications he/she will lead.

Proposing Research Group

The Software Engineering Research Group (SWEN) is recognized as one of the worldwide leaders in software engineering. Its members have been organizing and co-leading international conferences such as ICSA, ASE, ICPE, MODELS, and being active members of the organizing committee of conferences such as ICSE, ASE, FSE, MODELS, ICSA, ECSA, and others.

We ensure a supportive environment for career development.

- **Global Network:** Active participation in over ten Horizon Europe projects.
- **Infrastructure:** State-of-the-art facilities located in L'Aquila.
- **Mentorship:** Our supervisors have supervised tens of Ph.D. students and PostDocs, most of them holding a professorship or a practitioner position worldwide.

Our Support for Your Proposal

We don't just host you; we help you win. Candidates selected for this topic will receive:

- **MSCA Master Class:** A 1-day intensive workshop (July 2026) on proposal writing.
- **Expert Review:** One-to-one feedback from our scientists.

Candidate Requirements

- **Degree:** PhD in Computer Science, Software Engineering, or related disciplines. It must be obtained by Sept 9, 2026, and not earlier than Sept. 2018.
- **Publications:** A strong publication track record (e.g., high-impact journals and conferences)
- **Prior Knowledge:** Research focus on (Software Engineering or Software Architecture) and (Agentic AI or LLM) and (Sustainability or Energy consumption).
- **Language Proficiency:** Excellent command of spoken and written English, strong interpersonal skills, and the ability to work both independently and in a team.
- **Mobility Rule:** Compliance with the MSCA mobility rule. Among them, candidates must not have resided in Italy for more than 12 months in the 3 years before the deadline.

Interested?

Interested candidates should send the following to henry.muccini@univaq.it by **July 01, 2026** with subject “MSCA Postdoctoral Fellowships 2026”:

1. A brief CV (max 2 pages).
2. A motivation letter (1 page) outlining research alignment.
3. A 1-page summary of your proposed research idea.

We look forward to building a winning proposal with you!