

Prospects

No. 25/312 – 10 November 2025

TECH – Open source: a driver of technological independence?

- Open source is ubiquitous in most software infrastructures. 97% of modern codebases are made up of open source components¹.
- Today, open source is considered a strategic imperative. It plays a vital role in the economy and forms the basis of most technologies currently in use.
- However, it is difficult to measure the value of open source software due to its non-monetary nature and the lack of centralised monitoring of its use. As a result, it remains largely unaccounted for in economic analyses.
- The open source market continues to grow. It represents between €65 and €95 billion in annual value in the European Union. Based on the calculation of "replacement value", if every company using open source software had to develop it in-house, the market size would be estimated at around €8.2 trillion², or 2.8 times France's GDP.
- In a context of growing aspirations for French and European digital sovereignty, the use and development of open source software enables public and private organisations to reduce their dependence on foreign suppliers.

Open source demystified

Open source software is software whose source code is developed through public collaboration and is based on the use of a specific licence that meets

the criteria of free redistribution, free access and authorisation of modifications. This licence thus ensures the freedom to use, modify and redistribute the work to anyone who owns a copy.

The source code is the version of a program that is written by the developer and will then be compiled to produce machine code that can be executed by the computer.

Although commonly used interchangeably, the terms "open source" and "free software" are virtually equivalent but reflect different schools of thought. Open source software is defined by the ten articles of the "Open Source Definition", while free software is defined by four fundamental freedoms (to run the programme, study it, adapt it and redistribute it). However, the designation FLOSS "Free/Libre and Open Source Software" remains the term officially adopted by the European Commission.

Open source programs are distinguished not by the absence of a licence, as one might think, but by the specific freedoms that their licence grants. The MIT, Apache 2.0, BSD 3-Clause and ISC licences are among the ten best open source licences.

Open source is a key component in the most dynamic areas of digital technology, such as AI, Big Data, IoT³, IaaS⁴, and cybersecurity. Using an open source approach frees architects and developers from a set of external constraints and

¹ *Open Source Security and Risk Analysis Report*. (2025). Black Duck.

² According to Harvard's study on the value of open source, the amount corresponds to approximately \$8.8 trillion.

³ The Internet of Things (IoT) refers to a network of devices, vehicles, appliances and other physical objects equipped with sensors, software and network connectivity.

⁴ Infrastructure as a Service is one of the existing cloud computing solutions. It allows users to benefit from IT resources via the network. It offers on-demand access to computing power and storage space.

allows devices to be connected using the most appropriate protocols and technologies.

Beyond the paradox of free software: the ecosystem and economic models that sustain open source

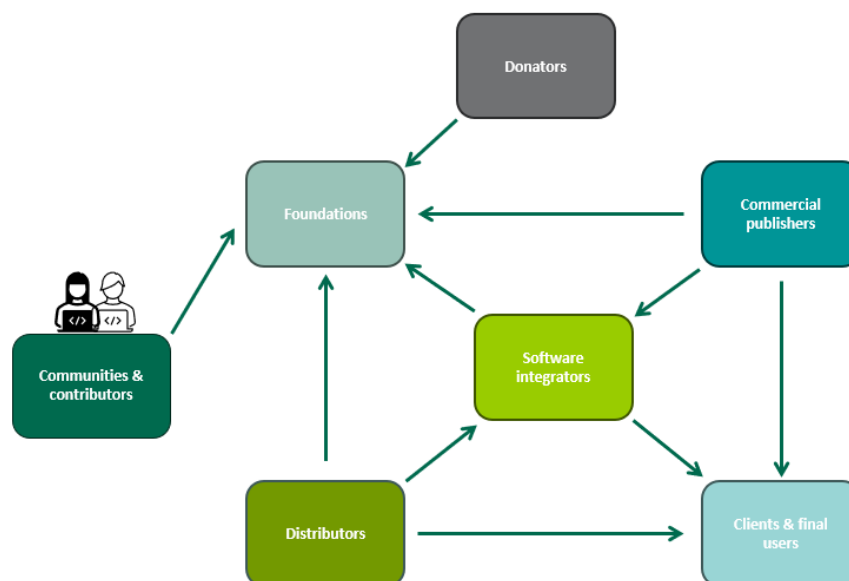
Contrary to popular belief, **open source is not simply about making software available for free.** Behind this apparent free access lies a sophisticated

economic ecosystem with its own mechanisms for creating value and financing.

A legitimate question arises when it comes to freely accessible software. **How can such a model be economically viable? If the end user does not pay directly, who finances the development and maintenance of these solutions?**

Within the open source ecosystem, there are different players.

The open source ecosystem and its various players



Source: Smile, Crédit Agricole S.A./ECO

Communities and contributors

A group of developers forming a "core team" who collaborate on software projects *via* open platforms. These volunteer contributors are motivated as much by peer recognition and personal satisfaction as by professional prospects. India, the United States and Brazil dominate, with the three largest public contributor bases respectively⁵. Despite having fewer contributors, developers based in the United States have contributed more to public and open source projects on GitHub⁶. This suggests greater activity per developer.

Foundations

Non-profit organisations (such as the Apache Software Foundation or Eclipse) are well suited to open source projects that have reached a certain level of maturity and make it easier to mobilise resources while offering legal protection. These organisations raise funds from corporate members and redistribute these resources to support development, events and infrastructure. Budgets

are fairly limited and are generally funded by large IT sponsor companies and generate small revenues from organising seminars, among other things. Project progress is mainly based on volunteering, but also on in-kind donations that companies can make by allowing some of their developers to work on projects during their working hours, for a period agreed upon with specific agreements.

Distributors and publishers

Private companies that publish their software under a free "open source" licence, offering additional features (Freemium model). Open source publishers generally have three types of revenue streams: licence sales, support and services – to which, in some cases, revenue from their integration partners can be added. Red Hat is the *leading* software publisher, with revenues of over \$1 billion. In 2019, IBM acquired it for approximately \$34 billion, making it the largest acquisition in software history⁷.

⁵ Octoverse 2025 Report

⁶ GitHub is a collaborative web platform for code version management and source code hosting.

⁷ Red Hat official website

Service providers

Complementary players that support businesses when there is no commercial structure behind free software. Their offering includes consulting services, training and module customisation. The publisher may offer paid partnerships to integrators, giving them access to a set of resources they may need. Depending on their level of certification, partner integrators benefit from privileged access to prospects identified by the publisher. They also have official recognition that allows them to stand out in tenders against non-accredited competitors, provided that the end customer is aware of the advantages associated with these certifications. Open source support providers, such as Smile and Linagora, for example, can also build specific applications, but their core business is in support, for example of ready-to-use products.

Governments and international organisations also fund open source projects, particularly in the fields of research and critical infrastructure. Scikit-learn, one of the leading *machine learning* libraries, is funded by public research grants, with the French government allocating €32 million to support its expansion as part of the "AI Strategy" programme. The funding model also includes private sponsorship and community donations. Led by Inria (the French National Institute for Research in Computer Science and Control), Scikit-Learn is the third most widely used open source *machine learning* software in the world⁸.

In the wake of Germany's *Sovereign Tech Fund*, one of the most successful government programmes dedicated to open source worldwide, GitHub is calling for the creation of a European sovereign fund. The aim would be to identify critical software dependencies within the European Union, finance their maintenance and security, and strengthen the ecosystem as a whole.

GAFAM, for its part, invests in open source in various ways: acquiring platforms (Microsoft's acquisition of GitHub in 2018), funding foundations (such as the Linux Foundation), launching projects and recruiting developers. For these digital giants, actively engaging with open source communities gives them the opportunity to discover technical talent and persuade them to collaborate with them.

The ubiquity of open source and its competitiveness with proprietary solutions

Nearly two-thirds of private and public organisations say they are open or very open to free software⁹. However, the high need for training and the lack of free software specialists are barriers to adoption. There may also be significant resistance to change when switching from proprietary software to open source software.

The main obstacles to the adoption of open source software include a lack of technical support, concerns about licensing and intellectual property, legal concerns and uncertainty about return on investment.

Incorporated into 96% of software solutions (some examples: Android, Linux, Python, Mozilla Firefox) and used extensively by the public sector (90% of organisations) and private sector (80% of companies), **open source is used at virtually every level of corporate IT**¹⁰.

Several key factors are driving the adoption of open source solutions. They are often cheaper or free, more flexible and benefit from greater longevity than their proprietary equivalents.¹¹ Companies would have to spend 3.5 times more on software than they currently do if open source software did not exist. In many areas, these solutions are relatively superior thanks to the large number of deployments and feedback.

Open source solutions are generally more compliant with standards and more open to the addition of extension modules with greater interoperability. Sustainability and alignment with European values and principles are other key selection criteria. The stability of open source technologies is also cited as a major advantage.

However, **using open source components requires the adoption of rigorous software procurement, updating and evaluation processes**, particularly in light of the rise of AI and increased regulation. The benefits of these models can only be realised with intentional governance and appropriate tools. Many security vulnerabilities stem from obsolete open source components.

⁸ Inria Foundation website

⁹ *Open Source Monitor France*. (2023). CNLL, Numeum and Systematic Paris-Region.

¹⁰ Information Systems: operating systems, containerisation technologies, application development and data management.

¹¹ Hoffmann, Manuel, Frank Nagle, and Yanuo Zhou. "[The Value of Open Source Software](#)." Harvard Business School Working Paper, No. 24-038, January 2024.

Financial and structural challenges

Despite its advantages and ubiquity in digital infrastructures, **open source suffers from a lack of visibility, a lack of awareness of its benefits and a lack of institutional support, which undermines its development and sustainability.** It remains largely undervalued and is rarely perceived as a real strategic lever by public authorities or economic players.

Many open source projects struggle to gain visibility because they rarely have communication or marketing teams. Improving open source software catalogues and their ease of use will enable them to compete with large technology companies. The French government has developed a catalogue of free software references, which allows all software developers working with the public sector to be listed.

Faced with the intensive use of their work without adequate financial compensation and the need to protect their revenues from competition from digital giants, **some companies in the open source ecosystem** (such as HashiCorp, MariaDB, MongoDB and Confluent) **are beginning to question their initial commitment and opt for less permissive and more restrictive licences**, such as the BSL (Business Source Licence) or the SSPL (Server Side Public Licence).

Some players are even attempting to redefine open source to their own advantage, in moves sometimes referred to as '*open washing*' by the open source community.

How can we quantify the economic impact of open source in Europe?

Europe is well positioned in the field of open source. It has 18.5 million contributors, representing 15.4% of the global workforce¹². At the forefront of the European open source movement, **France is home to a thriving market**, particularly in open source AI, with annual growth of 20% in active communities in 2024, according to the Octoverse report.

Open source represents between €65 and €95 billion in annual value in the European Union. A 10% increase in European contributions to open source would generate up to 0.6% more GDP — or nearly €100 billion (according to the European Commission)¹³.

However, **it remains difficult today to quantify precisely the economic impact of open source.** Since a significant proportion of products are used free of charge, the market share in terms of deployment is immensely greater than the market share in terms of turnover.

A study by Harvard Business School¹⁴ estimates that a group of programmers spread across the globe could recreate all widely used open source software at a cost of approximately \$8.8 trillion¹⁵.

Therefore, to more accurately understand the economic value of the open source ecosystem, an alternative approach would be relevant: evaluating these solutions according to their "proprietary replacement value", in other words, the cost that would have represented if equivalent proprietary software had been purchased.

Open source: a key solution for sovereignty and responsible digital technology

In Europe, the growing desire for economic autonomy and local products is fuelling enthusiasm for open source software. This desire for independence is driven by several factors: increased geopolitical tensions, issues surrounding personal data protection, and technological power concentrated in the hands of a small number of non-European players.

The use and development of open source software enables public and private organisations to reduce their dependence on suppliers, who are often foreign. The *Interoperable Europe Act* (IEA)¹⁶ promotes the use of free software. Under this law, public sector bodies are required to share interoperable solutions with the aim of removing technical and organisational barriers to cross-border digital services.

The management of the École Polytechnique has halted its migration to Microsoft 365. This migration contravened Article L123-4-1 of the Education Code, which requires universities and engineering schools to give preference to free software and open formats. The school is under the authority of the Ministry of the Armed Forces and hosts work related to strategic areas (cybersecurity, defence, quantum technology); migrating this data to an American host would have exposed sensitive information to the extraterritorial laws of the United States.

¹² *Open Source Manifesto*. (2025). Numeum.

¹³ *The impact of Open Source Software and Hardware on technological independence, competitiveness and innovation in the EU economy*. (2021). European Commission.

¹⁴ Hoffmann, Manuel, Frank Nagle, and Yanuo Zhou. "[The Value of Open Source Software](#)." Harvard Business School Working Paper, No. 24-038, January 2024.

¹⁵ Equivalent to €8.2 trillion

¹⁶ [The Interoperable Europe Act: Implications and impact on EU's digital future | data.europa.eu](#)

With this growing interest in European digital sovereignty and the rapid advancement of generative AI, open source is also present in this field and many LLMs¹⁷ are open.

Indeed, the first decisive steps in generative AI have largely relied on open source models and *frameworks*. **With its new DeepSeek-R1 model released in January 2025, China caused a technological earthquake thanks to its speed, power and open source nature.** 89% of organisations that have adopted AI use open source AI (OSAI) in some form in their infrastructure¹⁸.

Today, approximately 50% of notable AI models published are open source¹⁹. **Open source models democratise access to AI, accelerate innovation and intensify competition in the market, putting pressure on proprietary players to differentiate or adapt.** They thus reduce barriers to entry for model customisation and challenge the future growth rates of closed models.

Open source AI will thrive, particularly in areas where control, customisation and compliance are important.

In response to major industrial, climatic and geostrategic challenges, supporting open source represents a strategic investment to accelerate Europe's digital transformation, preserve its sovereignty and boost its economic growth.

Open source is used everywhere at the heart of modern digital infrastructures. It offers public and private organisations a unique combination of adaptability, security and interoperability that proprietary solutions struggle to match.

Furthermore, by reducing dependence on large non-European technology companies and securing critical infrastructure, open source is proving to be a powerful driver of strategic autonomy.

¹⁷ *Large Language Model*, AI language models

¹⁸ *The Economic and Workforce Impacts of Open Source AI*. (2025). The Linux Foundation.

¹⁹ Epoch AI graphs on the distribution of open/closed models

Consult our last publications

Date	Title	Theme
06/11/2025	Trump's Asian Tour: The Art of the Deal Returns	Asia, USA
04/11/2025	Europe – 2025-2026 Scenario: headwinds are easing, but new ones are emerging	Europe
23/10/2025	Morocco's politicised youth are forcing the country to reckon with its contradictions	Africa & Middle East
16/10/2025	Donald Trump and his bankers	USA
03/10/2025	World – Macro-economic scenario 2025-2026 – Hoping for a hint of stability...	World
03/10/2025	China: behind involution lie deep-seated economic imbalances	Asia
25/09/2025	Trump is right about the diagnosis but wrong about the remedies	USA, China, Europe
17/07/2025	China - Facing the business cycle: when planning meets doubt	Asia
30/06/2025	Europe – 2025-2026 Scenario: European economies in a waiting and transition phase	Europe
20/06/2025	World – Macro-economic scenario 2025-2026: a nerve-wracking context, some unprecedented resistance	World

Crédit Agricole S.A. — Group Economic Research

12 place des États-Unis – 92127 Montrouge Cedex

Publication manager: Isabelle Job-Bazille

Chief Editor: Armelle Sarda

Information centre: Elisabeth Serreau – **Statistics:** Datalab ECO

Editor: Sophie Gaubert

Contact: publication.eco@credit-agricole-sa.fr

Consult Economic Research website and subscribe to our free online publications:

Website: <https://etudes-economiques.credit-agricole.com/en>

iPad : [Etudes ECO application](#) available on App store platform

Android : [Etudes ECO application](#) available on Google Play platform

This publication reflects the opinion of Crédit Agricole S.A. on the date of publication, unless otherwise specified (in the case of outside contributors). Such opinion is subject to change without notice. This publication is provided for informational purposes only. The information and analyses contained herein are not to be construed as an offer to sell or as a solicitation whatsoever. Crédit Agricole S.A. and its affiliates shall not be responsible in any manner for direct, indirect, special or consequential damages, however caused, arising therefrom. Crédit Agricole does not warrant the accuracy or completeness of such opinions, nor of the sources of information upon which they are based, although such sources of information are considered reliable. Crédit Agricole S.A. or its affiliates therefore shall not be responsible in any manner for direct, indirect, special or consequential damages, however caused, arising from the disclosure or use of the information contained in this publication.