OPEN DIGITAL SOVEREIGNTY PROJECT

A PLAN TO BOOST EUROPE'S AI STACK

By Clara Riedenstein and William Echikson

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Executive Summary

History provides compelling evidence for the power of openness. When Vint Cerf and Robert Kahn made TCP/IP protocols open and free in 1974, they created the foundation for the Internet revolution. By making it open, almost the entire world was hooked up to the World Wide Web. Open standards generated similar success with the Linux operating system, GSM mobile phones, and the open web standard HTML5.

Openness lowers barriers, fosters innovation, and creates ecosystem effects that proprietary systems cannot match. Conversely, proprietary systems restrict adoption, slow ecosystem growth, and create dependencies that limit innovation.

Europe is debating two competing visions for digital sovereignty. The "Independence Approach" demands European production across every layer of the AI stack, requiring massive subsidies and "Buy European" procurement clauses. The alternative "Smart Interdependence" strategy recognizes that complete independence is neither realistic nor necessary, focusing instead on diversification, competitive markets, and leveraging Europe's existing strengths in industrial software, lithography, and chemicals. Smart Interdependence builds on top of openness.

Our analysis identifies critical intervention points across the AI stack:

Semiconductors: Although Europe cannot achieve manufacturing independence in advanced chips, it can and should leverage existing strengths—ASML's lithography dominance, Merck's chemical expertise, and Imec's research leadership. The focus should shift to promoting chip designs that support open software ecosystems.

Cloud Infrastructure: While data localization requirements create inefficiencies and vulnerabilities, openness breaks down borders, minimizes lock in and reduces vulnerabilities. Multi-vendor strategies and interoperability provide better security than geographic restrictions.

Software Stack: The middleware, which connects disparate applications, databases, and operating systems, determines whether Europe can innovate or remain locked into closed ecosystems. Open software frameworks enable hardware flexibility, cost efficiency, and optimization for European use cases. Proprietary alternatives create cascading dependencies.

Policy Recommendations

- Leverage Openness to Capture Value and Increase Customer Control.
- Attach Portability Conditions to Public Funding
- Focus on Boosting AI and Cloud Demand and Adoption
- Encourage Multi-Vendor Procurement Supporting Openness.

Semiconductor Design

- Limit the Entrenchment of Closed Ecosystems.
- Prioritize Hardware Supporting Open Software Ecosystems.
- Align Design Principles with Open Software Needs of AI Factories.

Cloud Computing

- Enforce Interoperability.
- Promote Effective Certification, Avoiding Sovereignty Requirements.
- Ease Data Localization Requirements.
- Embed Openness in the Cloud and AI Development Act.

AI Software

- Focus on Small Language AI Models.
- Develop “Edge” AI Capabilities.
- Clarify AI Regulation.

Open Digital Sovereignty transforms the concept from defensive protectionism into offensive innovation. By embracing openness in semiconductors, cloud infrastructure, and software layers, Europe can maintain technological sovereignty while participating fully in global innovation.

Introduction
Digital Sovereignty and Openness

Europe's rallying cry is Digital Sovereignty. The continent's motivations are understandable. As globalization comes under strain, it becomes uncomfortable, even risky, to depend on others for critical technologies. Yet a campaign to define Digital Sovereignty as complete independence from foreign sources is neither realistic nor necessary, and even potentially dangerous. Attempts to replace American, non-European tech, software, hardware, and services, would cost, according to several recent estimates, between €3 and €5 trillion,[1] without any guarantee of success. Europe cannot afford such decoupling. Even if it could mobilize such a gigantic sum, the duplication would be counterproductive and hurt the continent's ability to innovate.

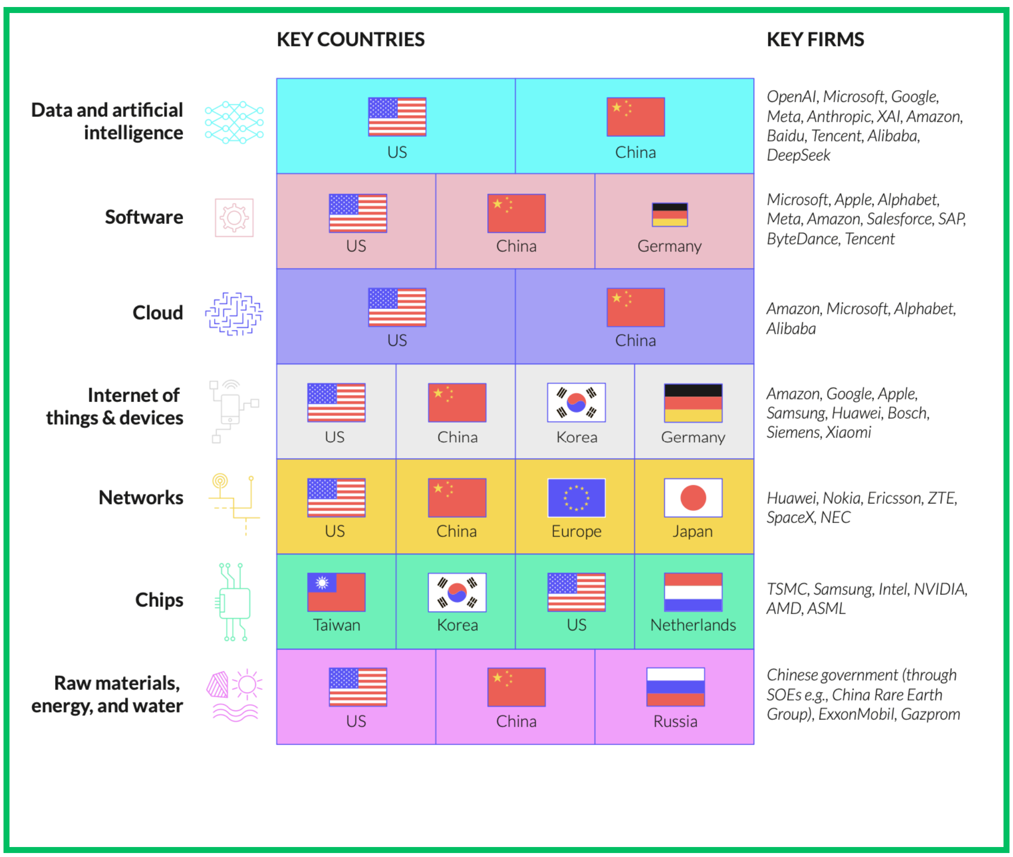
Instead of decoupling, we propose an Open Digital Sovereignty. Openness represents an inherent improvement over narrow, closed, and protectionist Digital Sovereignty. We adopt a broad definition of openness that goes beyond open source software. We use openness as an umbrella term that captures standards and software ecosystems. By openness, we mean a diversity in hardware and software that avoids lock-in and promotes interoperability. We mean enabling open, competitive markets. We mean open to suppliers wherever their geographic location. We mean open ecosystems where researchers and companies are able to collaborate across different technologies, and where the value they create stays with those who create it, not with whoever controls the platform.

Our focus is on parts of the artificial intelligence stack: semiconductors, cloud computing, and software stack. AI is shaping up to dominate the future's front line. AI capabilities will be diffused throughout all technology, including smartphones, sensors, cars, and other daily tools. How and who builds it will unlock economic growth and define much of our future world.

[1] Chamber of Progress, "New Report: Building a European Tech Stack Could Cost €5 Trillion," January 27, 2025, https://progresschamber.org/news/new-report-building-a-european-tech-stack-could-cost-e5-trillion/.

This policy brief is based on a review of existing literature and more than a dozen interviews with AI policy analysts and public and private business representatives. We talked with promoters of Digital Sovereignty EuroStack and their critics. We interviewed representatives from tech companies and civil society tech critics. The interviews were conducted on the Chatham House background rule, to allow for honest discussion. Our goal is to outline a pragmatic vision that allows Europe to boost its lagging self-confidence, accelerate AI adoption, benefit from the technology's productivity boost, and return to economic growth.

The AI Stack



Source: Eurostack

Chapter One

Openness as a Foundation for Digital Sovereignty

History demonstrates the power of openness. When Vint Cerf and Robert Kahn developed TCP/IP, governing how data moves through a network in 1974, they made the protocols open and gave them away for free.[2] Vint and Bob didn't become rich, and sometimes Vint expressed regret about his lost fortune. But he acknowledges that if he had not "opened" up the protocol, which he dubbed "Internet," few would have used it. "When asked to explain my role in the creation of the internet, I generally use the example of a city," Vint says. "I helped to build the roads—the infrastructure that gets things from point A to point B." Others built proprietary systems on top of his invention, fueling the Internet revolution.

Two decades later, Finland's Linus Torvalds released a free, open-source operating system software called Linux. While originally developed for personal computers, it is now used on a wide variety of devices, including workstations, mainframes, and servers, and is used in all the world's 500 fastest supercomputers. Europe next benefited from open standards in mobile phones, with its GSM mobile standard outperforming the American proprietary CDMA standard.

Proprietary technology ecosystems often restrict adoption, slow ecosystem growth, and inhibit competition. They can function as practical gatekeepers on supply, accessibility, and innovation. It is easy to shut down a proprietary system. The owner controls it. In contrast, it is difficult to shut down a system run on open source. No one "owns" it. Anyone can build on top of it. Security of supply, never absolute, can be reinforced by maintaining vendor diversity. Multiple foreign vendors competing for European business is better for sovereignty than single-vendor dependency on any supplier, even a hypothetical European one. Open standards and open source allow for this diversification and competition.

[2] "A Short History of the Internet," *Science and Media Museum*, December 3, 2020, https://www.scienceandmediamuseum.org.uk/objects-and-stories/short-history-internet#what-is-tcp-ip.

Even though proprietary hardware and software dominate the current global AI landscape, open products are making important inroads. As many as 80% of American AI start-ups rely on capable and affordable open Chinese models, Silicon Valley venture capitalists estimate.[3] Chinese models now account for 17.1% of global downloads, ahead of the US at 15.8%, according to new research from MIT and Hugging Face, a repository of open-source AI models and datasets.[4] Only two years ago, American models dominated with more than 60% of downloads.

Although the reliance on Chinese software comes with its own political and ethical risks, open standards overall lower barriers, foster wide participation, accelerate innovation, and create ecosystem effects unavailable from proprietary vendors. Open AI ecosystems enhance the security and transparency of complex, expensive-to-build AI infrastructure. They promote interoperability, which reduces dependence on any single supplier, not by eliminating them, but by giving European customers increased choice and control. They keep cutting-edge tech available to Europeans. They secure supply since it is difficult to put a “kill switch” – cut off access - on an “open” model. Interoperability also allows Europeans to innovate on top of existing ecosystems. Openness turns Digital Sovereignty from a form of protection against foreign tech to a form of promotion of Europe's strengths and increases the ability for Europe to participate in the value chain.

Despite the examples and the benefits of open standards, it is far from certain that open AI ecosystems will win out. Openness alone does not represent a silver bullet. Even though open source can be more secure than third party software because developers get insight into how the code is written, it must overcome the perception that it is less secure and trustworthy than proprietary solutions.

It's also important to recognize that the debate is not binary. It is not 100% open vs 100% proprietary. Some proprietary tech relies on open standards and open source. Companies that are basically proprietary might still release some open source tools.

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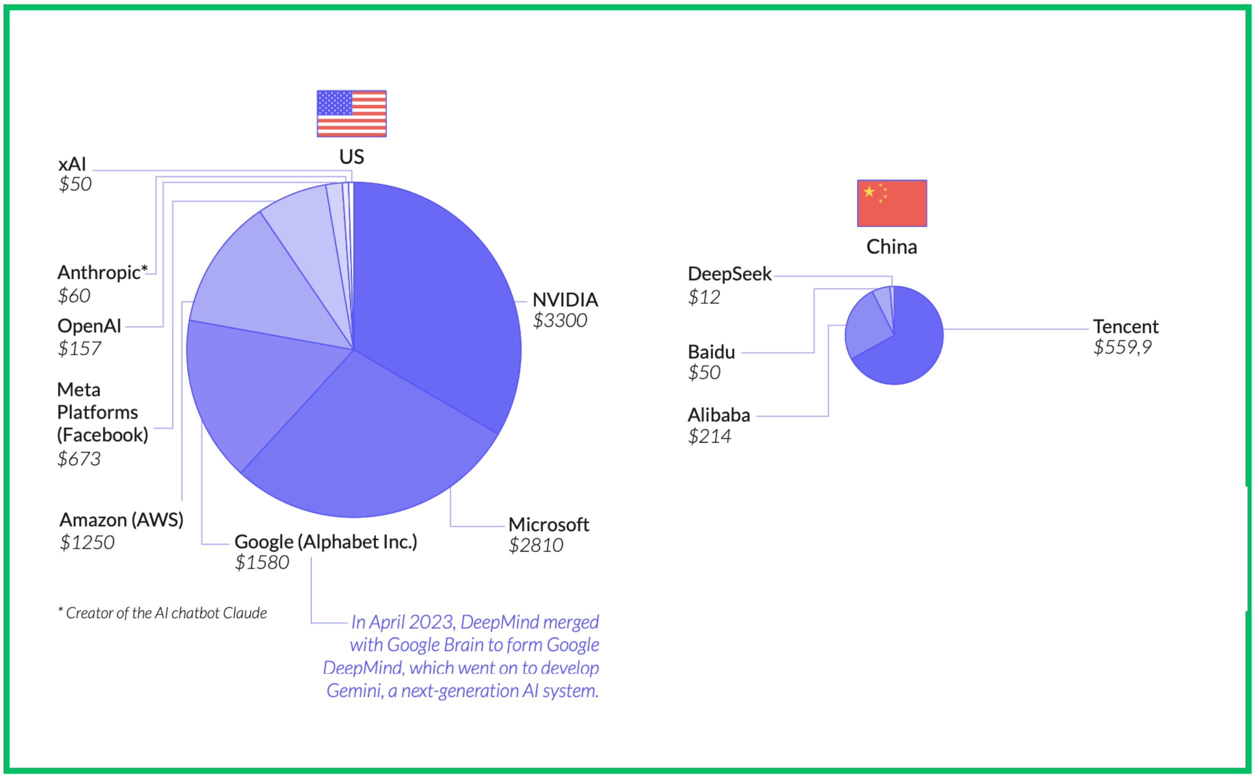
[3] “China Is Quietly Upstaging America with Its Open Models,” *The Economist*, August 21, 2025, https://www.economist.com/business/2025/08/21/china-is-quietly-upstaging-america-with-its-open-models.
[4] Shayne Longpre et al., *Economies of Open Intelligence: Tracing Power & Participation in the Model Ecosystem*, Data Provenance Initiative, August 2025, https://www.dataprovenance.org/economithird-partyes-of-open-intelligence.pdf.

US And China Dominate



Source: Companies Market Cap and Eurostack

Defining Openness

When referring to openness, a technology is often described as "open source" or "proprietary." In fact, openness extends beyond this simple binary notion of open and closed. Technologists themselves disagree on how to define open source. Gradations exist. Below is an attempt to define the various forms of openness in AI products.

Open Source: *A software is open source if its source code is publicly accessible, modifiable, and can be built on by a community. Examples of open source software include the Linux operating system or Mozilla Firefox browser. The open nature of the software means developers can fix errors and add to it, improving the software by pooling their expertise. The worry is this can also allow users to modify pieces of software in harmful ways, such as removing safety protections. Open source software also is more challenging to monetize compared to proprietary code.*

Open Weight: *An AI model is open weight if it allows users to access its trained parameters (i.e. weights), but doesn't provide access to its source code or training data. Most "open source" models, such as the recently released version of OpenAI's ChatGPT, are in fact "open weight." Open weight models limit community collaboration and replicability,*[5] *characteristic of open source software. If neither the code nor the AI product's dataset are publicly accessible, then the gap between proprietary and open-source models narrows.*

Open Software Ecosystem: *An open software ecosystem consists of interoperable software that can run on any hardware. Interoperability means that users can switch easily from one provider to another and exchange data between systems. On a technical level, this often involves employing common open standards and APIs. Software can be proprietary and still be interoperable, and lack interoperability while remaining open source.*

[5] "Open Weights," Open Source Initiative, https://opensource.org/ai/open-weights.

Open Standards: Open standards are principles about how software can be compatible across platforms. A standard such as PDF or Wi-Fi is open because it allows users to employ the software across different vendors. Data from Adobe to another PDF reader is possible because PDF is an open standard recognized by other vendors.

Chapter Two

The Sovereignty Debate: Independence or Interdependence

Over the past year, journalists, think tankers, and politicians have published numerous reports on Europe's quest to achieve Digital Sovereignty, revealing two competing visions.

One view of Digital Sovereignty is to insist on buying from "independent" European technology suppliers: **the Independence Approach**.[6] A proponent, the EuroStack initiative, insists Europe must produce every layer of the AI stack to regain control over technology. Key proposals include the establishment of a €300 billion "European Sovereign Technology Fund" and "Buy European" clauses in public procurement contracts.

Despite the arguably protectionist vision, this view champions open source as a European value reflecting transparency and accountability.[7] Key proposals include, for instance, the prioritization of European open-source solutions through "preferential procurement and incentives for private adoption" across all layers of the AI stack.

For Eurostack proponents, another benefit of openness is to promote interoperability, which mitigates risk and dependence on foreign suppliers. Insofar as reliance on non-European companies remains a necessity in some areas of the AI stack, interoperability allows Europe to remain in control, and companies can innovate on top of existing systems. For instance, EuroStack suggests requiring open APIs for cloud providers to "ensure interoperability, support cross-border data flows, and

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[6] Andrea Renda, "A Bold Proposal to Build the EuroStack – Because Doing Nothing Isn't an Option Anymore," *CEPS*, February 13, 2025, https://www.ceps.eu/a-bold-proposal-to-build-the-eurostack-because-doing-nothing-isnt-an-option-anymore/.

[7] Francesca Bria et al., *EuroStack: A European Alternative for Digital Sovereignty*, Bertelsmann Stiftung, February 2025, https://assets.filedock.xyz/public/EuroStack_2025.pdf.

prevent vendor lock-in".[8] The goal is to create a "truly open public AI marketplace for Europe."

A competing vision of Digital Sovereignty views the goal as "**Smart Interdependence**." German Marshall Fund scholar Ansgar Baums and others argue that complete independence is neither realistic nor necessary.[9] This approach begins from the assumption that no digital supply chain will ever be fully independent, so the best approach is not to seek digital independence, but digital diversification, promoting chokepoints, and boosting Europe in sectors where it's already a world leader.

Concrete proposals reflect this smart interdependence strategy. Brussels-based think tank ECIPE argues that Europe could boost its efficiency and security in the public sector by opting for multi-vendor cloud solutions.[10] Rather than a split between European or non-European cloud providers, this solution encourages public sector buyers to contract with various companies to store their data. Another Brussels think tank, CERRE, as well as several interviewees, argued that Europe should double down on its comparative advantage in industrial software, lithography, and chemicals.[11]

Openness plays a central role in smart interdependence. In contrast to the Eurostack approach, Smart Interdependence focuses less on open source as an ideological goal, and more on interoperability to mitigate risk. Agreed-upon open standards, particularly at the cloud infrastructure level, are essential to preventing European companies from being locked into a single provider. Open architectures enable European companies to build on top of existing AI software, allowing European suppliers to build models targeting European strengths in industrial B2B.

[8] Francesca Bria et al., EuroStack, 109.
[9] Ansgar Baums and Manuel Kilian, "Better Stack (Part 1): 10 Theses to Demystify the Debate on Digital Sovereignty and the Euro-Stack," *GovTech Intelligence Hub*, August 19, 2025, https://www.govtechintelhub.org/case-study-details/better-stack-%28part-1%29:-10-theses-to-demystify-the-debate-on-digital-sovereignty-and-the-euro-stack/aJYTG0000000te14AA.
[10] Matthias Bauer et al., "Boosting Efficiency and Quality in EU Public Services: The Need for a European Multi-Cloud-First Strategy", *ECIPE*, March 2025, https://ecipe.org/publications/boosting-efficiency-and-quality-in-eu-public-services-egovernment/.
[11] Zach Meyers, "Can the EU Reconcile Digital Sovereignty and Economic Competitiveness?", *CERRE*, September 2025, https://cerre.eu/wp-content/uploads/2025/09/CERRE_Issue-Paper_EU-Competitiveness_Can-the-EU-reconcile-digital-sovereignty-and-economic-competitiveness.pdf

Both the independence and interdependence camps acknowledge the limitations of open source solutions. Security breaches like the XZ Utils backdoor raise concerns. Many "open" AI models only release weights while keeping training data private. Chinese models like DeepSeek, despite technical achievements, carry political risks—their licenses notably omit restrictions on surveillance uses, suggesting that DeepSeek aligns with Chinese authoritarians. China leads globally in developing AI tools for surveillance and population management, and serious human rights concerns have been documented.[12]

While disagreements remain among those concerned with Europe's digital future, most analysts accept that openness, broadly defined to include interoperability, open standards, and antitrust enforcement, will play a key role.

[12] Fergus Ryan et al., "The Party's AI: How China's New AI Systems Are Reshaping Human Rights", *Australian Strategic Policy Institute*, December 1, 2025, https://www.aspi.org.au/report/the-partys-ai-how-chinas-new-ai-systems-are-reshaping-human-rights/.

Chapter Three
Supporting Open Software Semiconductors

Advanced semiconductors drive the AI stack. The design of semiconductors determines what software is compatible with the chips. Thus, semiconductor design dictates critical digital procurement and strategic autonomy on the level of AI software and cloud infrastructure. Demand is soaring for these cutting-edge chips used for machine learning to train language models, data analysis, and natural language processing. The market for graphic processing units (GPUs) is estimated to grow from around $82 billion in 2025 to a staggering $350 billion in 2035.[13]

The semiconductor value chain is complex, requiring specializations spread across the globe. No one region dominates. According to the 2025 report on European competitiveness authored by former Italian Prime Minister Mario Draghi, Europe currently has no foundry producing below 22 nm nodes, with Samsung and Taiwan's TSMC holding market dominance.[14] The US leads in chip design through companies like NVIDIA and AMD, while the Netherlands' ASML dominates lithography equipment essential for manufacturing.

ASML relies on a complex, wide-ranging network of European optical suppliers. German technology leader Merck produces chemicals needed in chipmaking, and has focused its efforts on AI chips.[15] Belgium's Imec, a part of the University of Leuven, leads the world in research on lithography and exotic chipmaking materials.[16]

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[13] Mordor Intelligence, "*Graphics Processing Unit (GPU) Market Size & Share Analysis - Growth Trends & Forecasts (2025 - 2030)*, June 18 2025, https://www.mordorintelligence.com/industry-reports/graphics-processing-unit-market.
[14] Mario Draghi, *The Future of European Competitiveness – A Competitiveness Strategy for Europe*, European Commission, September 9, 2024, https://commission.europa.eu/topics/competitiveness/draghi-report_en.
[15] Chris Miller and John Allen, "Europe Is Losing the Chips Race: The Continent Needs More Cooperation With America—Not Less," *Foreign Affairs*, October 16, 2025, https://www.foreignaffairs.com/europe/europe-losing-chips-race.
[16] Imec, "Imec: World-Leading R&D Hub in Nanoelectronics and Digital Technologies," https://www.imec-int.com/en

Global interdependence in the semiconductor supply chain creates vulnerabilities that go beyond just manufacturing and include chip design priorities. The key is maintaining competitive markets by favoring funding chip design compatible with open software ecosystems, avoiding undesirable lock-in to proprietary chips.

Although various mechanisms exist to mitigate vendor lock-in - and interviewees noted that the precise degree of such lock-in remains subject to debate - the strong economic, structural, and performance-based incentives to rely on a closed software ecosystem can constitute a meaningful lock-in effect in practice. If researchers and engineers prefer one suite of tech because they're used to it—because that's what they learned, because that’s what the documentation covers and what the community supports—that effectively becomes the operating standard, making it possible for single actors to seek and reach exclusive arrangements with other vendors, which effectively amounts to a lock out for other vendors that adhere to open standards.

A Look Back

The roots of GPU semiconductors can be found not in Silicon Valley, but in the UK. British computer scientists founded Inmos in 1978 in the port city of Bristol, to produce an innovative microprocessor architecture intended for parallel processing. Inmos called it the transputer. The transputer connected a series of microprocessors with built-in communication links designed to be connected in parallel to achieve supercomputer-level performance.

At the time, Intel and other chips gave out one instruction at time. Inmos processors combined multiple processors, a precursor of modern GPUs. Inmos developed the Occam programming language to leverage its transputer's novel parallel-processing hardware. The software was proprietary, tightly wedded to its own language and tool chain, stifling third-party adoption. But problems soon emerged. Programming multiple processors to work together proved difficult.

New languages, C and C++, soon emerged to manage parallel processing. They were open. Developers added extensions, and general-purpose CPUs combined with evolving parallelism libraries became the default for scalable computing.

The proprietary Inmos/Occam/transputer stack faded. In April 1989, the French Italian firm SGS Thomson, now STMicroelectronics, bought Inmos. Work on an enhanced transputer, the T9000, encountered various technical problems and delays, and was eventually abandoned, signalling the end of the development of the transputer as a parallel processing platform. In December 1994, STMicroelectronics discontinued the Inmos brand name.

Chapter Four
Cloud Computing: From Walls to Bridges

Cloud computing forms the backbone of the AI revolution. Without scalable computing power and storage, AI models cannot be trained or deployed effectively. Yet Europe lags: while US cloud adoption has reached 60%, European companies hover at 41%. This gap represents both a challenge and an opportunity for Europe to build sovereignty through openness rather than isolation.

Three US hyperscalers—Google, Microsoft, and Amazon Web Services (AWS)—have captured 70% of Europe's cloud computing market,[17] and about 80% of European spending on cloud and software services goes to American companies.[18] Europe is divided over how to respond. France[19] and other countries warn against the peril of storing sensitive European data with US companies. European initiatives such as the Data Act, the Cloud and AI Development Act, and the EU Cybersecurity Certification Scheme (EUCS) generate divisive debates over sovereignty requirements.

Openness can provide much, even if not total, of the desired reassurance. In the context of cloud computing, openness means promoting interoperability, easing the transfer of data from one supplier to another, and diversifying data localization. This presents a more effective strategy to achieving European cloud sovereignty than existing measures that focus on the geographic location of corporate headquarters.

The traditional approach to cloud sovereignty focuses on data localization and geographic restrictions. The EU's Cloud Sovereignty Framework, released in October

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[17] "Cloud Market Gets its Mojo Back; Q4 Increase in Cloud Spending Reaches New Highs," *Synergy Research Group*, February 1, 2024, https://www.srgresearch.com/articles/cloud-market-gets-its-mojo-back-q4-increase-in-cloud-spending-reaches-new-highs.

[18] Elvire Fabry, "Over-dependencies in services: A blind spot in the EU economic security strategy?" in *Turning the Tide: Towards Open Economic Security – Ten Reflections*, Brussels Economic Security Forum, Brussels Economic Security Forum, EPC, June 5, 2025, https://institutdelors.eu/en/publications/over-dependencies-in-services-a-blind-spot-in-the-eu-economic-security-strategy/.

[19] Ministère de l'Économie, des Finances et de la Souveraineté industrielle et numérique, "Le Gouvernement présente sa stratégie nationale pour le cloud," May 17, 2021, https://www.economie.gouv.fr/cloud-souverain-17-mai.

2025, sets eight “sovereignty objectives” for public procurement, many focused on corporate headquarters location rather than effective control.[20] Thirty-five EU measures require data storage within national borders, creating inefficiencies that undermine competitiveness.

Ukraine's experience demonstrates why openness matters more than location. When Russian cyberattacks in 2015-2016 paralyzed Kyiv's energy grid, Ukraine relocated critical data to cloud providers outside the country. This strategy proved prescient when Russia invaded in 2022—the Kremlin's FoxBlade malware offensive failed because Ukraine's data, including banking systems, resided safely in distributed cloud infrastructure. ATMs kept working while bombs fell.

Data localization also creates economic inefficiencies. Companies build data centers in high-cost Luxembourg to comply with banking regulations, when Nordic countries offer cheaper land and energy. One analysis found Luxembourg data centers cost 25-50% more than facilities just across the border in Belgium. Germany attracts data centers despite energy costs three times higher than in the US, purely for compliance reasons.

A smarter approach for cloud sovereignty involves embracing openness through multi-vendor strategies and interoperability. The US Department of Defense's 2022 cloud contract, awarded jointly to Amazon, Google, Microsoft, and Oracle, demonstrates how vendor diversity enhances security while meeting stringent requirements. No single provider can create lock-in or become a single point of failure.

For Europe, this means focusing on three priorities:

1. **Accelerate cloud adoption through open standards.** Rather than restricting providers based on headquarters location, require all cloud services to support data portability and standard APIs. This ensures European customers maintain control regardless of vendor nationality.

[20] European Commission, *Cloud Sovereignty Framework*, action document, October 20, 2025, https://commission.europa.eu/document/09579818-64a6-4dd5-9577-446ab6219113_en.

2. **Enable efficient infrastructure.** Streamline the present slow delivery of building permits for data centers. Allow companies to locate facilities where economics and energy provision dictate, using legal frameworks like Estonia's “data embassy” model to maintain sovereignty over sensitive data. European energy costs run up to three times more than in the US. A sovereignty priority to make the continent competitive is to bring them down.

3. **Leverage cloud as an innovation platform.** Open cloud infrastructure allows European companies to build AI applications without massive capital investment. The announced 19 AI Factories and five AI Gigafactories cannot function without scalable, interoperable computing resources.

The public sector alone could unlock €450 million in annual savings through efficient cloud adoption. More importantly, open cloud infrastructure provides the foundation for Europe's AI ambitions. By focusing on openness rather than geographic restrictions, Europe can build resilient infrastructure that supports innovation while ensuring security. The goal is not to exclude foreign providers but to ensure no single provider—foreign or domestic—can lock in European customers or data.

Cloud sovereignty should not mean building walls around data. True sovereignty comes from maintaining choice and control through open standards, vendor diversity, and competitive markets. This approach transforms cloud infrastructure from a vulnerability into a platform for European innovation and growth.

Chapter Five
The Decisive Layer: Software

Think of AI, and end-user software appears to represent the crown jewels. OpenAI's ChatGPT, Google's Gemini, and Anthropic's Claude have captured the public's imagination with their powerful performances.

Yet the fascination with large language models overlooks the importance of the crucial software stack that sits, unseen to consumers, between semiconductors and AI applications. This software layer consists of modules, including frameworks, compilers, runtime environments, and toolchains. Developers build on this software, which orchestrates the development work of AI models and applications.

Two competing approaches have emerged to manage this software linking chips and AI applications: a closed approach that bundles proprietary software with specific hardware, and an open strategy that enables flexibility across vendors. The distinction matters. How Europe treats this software layer will do much to determine whether European developers and users can innovate in AI or remain locked into a closed environment controlled by non-European companies and technology.

To understand, think about personal computers. Most modern PCs run on an operating system such as Windows or Linux. The operating system provides well-documented interfaces (APIs) that allow applications to access the underlying hardware. They are hardware-agnostic – they run on processors from various vendors.

When any developer writes software for Windows, he relies on Microsoft's APIs to provide those interfaces for his software to talk to the hardware. The APIs allow open-source programs such as Libre Office to run as efficiently as Microsoft's own applications such as Office 365.

In the AI world, it's a similar story. AI models from companies such as OpenAI or Anthropic run on top of a deep software stack that acts almost like an "operating system." It provides the APIs that allow software to access and utilize the underlying hardware efficiently. If chip manufacturers tie their proprietary software stack (i.e., their "operating system") to their own hardware – unlike Windows or Linux, however, they create structural dependencies that ripple through the entire AI stack. Applications written for proprietary software cannot easily migrate to other processors. If more suitable applications emerge, prompting users to switch vendors, training investments, optimization work, and institutional knowledge become stranded assets.

Lock in risks spread. When universities teach proprietary tools, when documentation assumes specific frameworks, when the developer community rallies around closed platforms, they become de facto standards. New entrants face not just technical barriers but ecosystem-wide network effects.

Consider an ambitious European AI developer. During their computer science education at one of the continent's top-flight universities, they work extensively with a predominantly proprietary software ecosystem. After graduation, the developer raises money to develop an AI model and must choose the technological foundation for their work. Given the constraints of their educational experience, the selection of software for the development pipeline becomes predetermined.

If, on the other hand, ambitious European developers study on an open software stack, they could then choose between various tools, saving money while increasing their control over their end model. The developers can build, experiment, and differentiate without being locked into a single vendor. That's why the openness of the software stack beneath the model layer remains critical for competition and innovation.

An open software stack enables new entrants to compete on efficiency, safety, and application-level innovation, regardless of whether the top-level AI models deployed are open or closed. Open alternatives provide vendor-neutral paths for the development of AI models. They allow code portability across different hardware platforms. AI models trained on open frameworks can run on processors from multiple vendors, mixing and matching them for appropriate workloads, all without major recoding.

The benefits cascade through the entire AI stack. Developers can choose processors based on performance, price, and availability, rather than software compatibility. They save money. They gain freedom. They can optimize for specific use cases without navigating proprietary restrictions. Industrial AI applications, where Europe leads, often benefit from specialized implementations impossible within closed ecosystems.

Open software enables workload optimization. Not all AI tasks require cutting-edge graphics processing units (GPUs). Inference, the process of using a trained machine learning model to make real-time predictions or generate content, often runs efficiently on simpler central processing units (CPUs). Open software is agnostic to the underlying hardware. It avoids forcing certain workloads on specific hardware, and redirects workloads appropriately to the most efficient hardware components for that specific workload rather than forcing everything through GPU bottlenecks.

The software layer mediates how chips communicate with application code. When proprietary, it limits transparency and restricts developers' ability to modify or optimize the underlying application. Developers must work within the chipmaker's constraints and tools, potentially missing opportunities to customize optimizations that could best serve their specific use cases. Open software removes these barriers.

Potential cost savings are enormous. While no extensive studies have been made about the software stack so far, comparisons exist between open and closed AI models. A recent study by MIT economist Frank Nagle concludes that open source AI models are on average six times cheaper to use than equivalent closed models.[21] If users were to choose the best observable AI model based on both price and performance, Nagle says they could save $20 to $48 billion a year.

No wonder open-source models are fast gaining market share. After China's cheap, competitive DeepSeek burst on the scene last year, open-source models became a

[21] Frank Nagle, "Revealing the Hidden Economics of Open Models in the AI Era," *The Linux Foundation*, November 19, 2025, https://www.linuxfoundation.org/blog/revealing-the-hidden-economics-of-open-models-in-the-ai-era.

potent alternative. Today, as many as 80% of American AI start-ups rely on Chinese open-weight models, Silicon Valley venture capitalists estimate.[22] Chinese models account for 17.1% of global downloads, ahead of the US at 15.8%, according to new research from MIT and Hugging Face, a repository of open-source AI software and datasets.[23] Only two years ago, American models dominated, with more than 60% of downloads.

Europe's AI Factories and Gigafactories face a critical choice. If chips with closed software architectures are selected, they will lock these massive public investments into single-vendor dependencies for decades. Instead, Europe should adopt open software layers in public AI infrastructure. This doesn't mean excluding any vendor based on its geographic origin; proprietary hardware can support open software interfaces. Rather, it ensures that public investments create genuine platforms for innovation.

The Gigafactory precedent matters. The software architecture chosen for them will influence private sector decisions, shape university curricula, and determine whether European AI becomes genuinely sovereign or merely hosted locally while controlled from abroad. If the open choices are made, European researchers will be empowered to develop new frameworks, optimize for local use cases, and build competitive advantages rather than merely consuming foreign technology.

Open AI software embodies much of the difference between digital sovereignty and digital dependency. By ensuring the software layer remains open, Europe can build on global innovation while maintaining the freedom to chart its own course. The alternative, accepting proprietary lock-in, will transform sovereignty investments into gilded cages, impressive in scale but limited in effectiveness.

[22] "China Is Quietly Upstaging America," *The Economist*.
[23] Longpre et al., *Economies of Open Intelligence*.

Chapter Six
Policy Recommendations

Even if Europe invests billions in its digital independence, it is unlikely to achieve its goal of digital self-sufficiency. Duplicating other countries' capacities will fail to improve competitiveness. The best path forward is promoting openness.

Even if the US and Chinese government and companies enjoy a head start and formidable resources, Europe need not give up hope. It should make Europe work smarter, not harder. Rather than trying to achieve digital independence, it should achieve digital interdependence. It should boost its own capabilities. Openness is key.

The following policy recommendations aim to increase Europe's ability to benefit from AI development and adoption.

- **Abandon Full Decoupling:** Move away from attempts to achieve complete independence from foreign tech sources, which is estimated to cost between €3 and €5 trillion and could stifle innovation.

- **Leverage Openness:** Open ecosystems allow European companies to customize AI for their applications and keep the competitive advantages they develop. Proprietary platforms capture value for platform owners; open platforms let value accumulate with innovators.

- **Attach Portability Conditions to Public Funding:** When taxpayer money funds AI infrastructure, the resulting code should run on multiple platforms, models should be deployable without vendor permission, and skills should transfer. These conditions ensure that investments build lasting European capabilities rather than deepen dependence on proprietary technology.

- **Embed Openness in the Cloud and AI Development Act:** This crucial upcoming proposal should give operational meaning to Europe's stated commitment to openness. Definitions of “sovereign” capacity should avoid insisting on European ownership or incorporation; instead, they should insist on interoperability and forbid single vendor lock-in regardless.

- **Focus on Demand and Adoption:** Shift the focus from purely building infrastructure (supply) to actively boosting AI adoption (demand), as currently only 13.5% of European companies use AI compared to 20-40% in the US.
- **Increase Customer Control:** Interoperability standards should exist on all levels of the AI stack, from cloud computing to semiconductors. European customers must enjoy the freedom to switch suppliers to ensure their ability to innovate.
- **Multi-Vendor Procurement:** Interoperability allows for procurement contracts with more than one vendor. This reduces risk for customers and boosts competition.

Semiconductors

- **Limit the Entrenchment of Closed Ecosystems:** Instead of pouring billions into buying chips that reinforce already entrenched proprietary software ecosystems, public funds should avoid increasing dominance and lock-in.
- **Prioritize Hardware Supporting Open Software:** Public funds should favor chips that foster interoperability and open software.
- **Align Design Principles with Open Software Needs of AI Factories:** EU-funded chip designs should support open software to reduce reliance on closed, single-vendor proprietary technology.

Cloud Computing

- **Prioritize Interoperability:** Avoid vendor lock-in in the cloud (including when engaging with US hyperscalers) by requiring open standards and APIs that allow for data migration and multi-vendor purchases.

- **Promote Effective Certification:** Certification schemes should be based on evidence of openness and interoperability, not geographic location.
- **Ease Data Localization Requirements:** Promote diverse data localization that increases redundancies and thereby promotes security.

AI Software

- **Focus on Small Language Models**: Instead of trying to duplicate massive US or Chinese AI models, invest in specialized, economically viable models for science, industry, and vertical B2B businesses.
- **Develop "Edge" AI Capabilities:** Capitalize on European industrial data strengths by promoting software that allows AI to run directly on devices ("the edge") rather than always relying on the cloud.
- **Clarify AI Regulation:** Address the "vagueness" and "ambiguity" of the EU AI Act by including clear definitions and actionable and objective compliance requirements to ensure that startups can operate with certainty and continue to innovate.

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William Echikson is a Non-resident Senior Fellow with the Tech Policy Program and editor of the online tech policy journal Bandwidth at the Center for European Policy Analysis (CEPA).

Before joining (CEPA), he worked at Google for six and a half years, running corporate communications for Europe, the Middle East, and Africa. He began his career as a foreign correspondent in Europe for a series of US publications, including the Christian Science Monitor, the New Yorker, Wall Street Journal, Fortune, and BusinessWeek. He is the author of four books, including works on the collapse of communism in Central Europe and the history of the Bordeaux wine region. He also directed and wrote documentaries for BBC and PBS.

An American and Belgian citizen, Mr. Echikson graduated from Yale College with a Magna Cum Laude degree in history. He spent a year at the Harvard University Russian Research Center. He is based in Brussels.

Clara Riedenstein is a tech policy analyst and writer whose work examines how emerging technologies shape existing political, legal, and social institutions. She is a researcher with the Tech Policy Program at the Center for European Policy Analysis (CEPA), where she regularly contributes to the online journal Bandwidth. Her work has been featured in DW, Tech Policy Press, and European View.

Clara holds an MSc in Political Theory from Oxford University, where she studied as a C. Douglas Dillon Scholar and focused on the implications of large language models for theories of jurisdiction. She also received a BA from Oxford, where she was awarded the Henry Wilde Prize in Philosophy (proxime accessit).

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