

EU STEP Programme

How Europe Finally Realised the Strategic Value of Technological Sovereignty

Research notes

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EU STEP PROGRAMME

How Europe Finally Realised the Strategic Value of Technological Sovereignty

Linking technology sovereignty and localized SDGs to rebuild resilience from the Mediterranean

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Executive Summary

The Strategic Technologies for Europe Platform (STEP) is a new EU initiative that aims to strengthen Europe's capacity in key technologies by consolidating and redirecting existing funding instruments. Officially launched in 2023, STEP represents the European Union's first coordinated effort to address technological sovereignty as a strategic priority — not only for global competitiveness, but as a cornerstone of resilience across its economies, societies, and territories.

This notebook argues that technological sovereignty is not an abstract policy concept: it is a territorial and operational capacity, and it is deeply intertwined with the localization of the United Nations 2030 Sustainable Development Goals (SDGs). According to the UN framework, SDG localization means embedding global sustainability goals into the local institutional, productive, social and ecological fabric — making them actionable and relevant at regional and municipal levels.

Over the past decades, Europe has progressively relinquished its technological autonomy, favouring deregulated markets, fragmented research and innovation strategies, and industrial delocalisation. The consequences have been profound: erosion of critical design capabilities, systemic dependencies, and increasing exposure to external shocks — from the COVID-19 crisis to energy insecurity and geopolitical fragmentation.

The STEP programme signals a belated yet decisive shift. But to be effective, it must go beyond funding and investment, and address the structural link between technological sovereignty, territorial resilience, and SDG localization.

This notebook explores that link through three interconnected parts:

- *Part I unpacks the core concepts of technological sovereignty and SDG localization*, showing how they function as interdependent levers of strategic resilience. It clarifies their meaning, institutional evolution, and operational relevance for building capacity at territorial scale.
- *Part II offers a critical diagnosis of the European context*, identifying major structural weaknesses: the loss of design and engineering capabilities, the fragmentation of research and education systems, and the political erasure of sovereignty, especially in key regions such as Italy and the Euro-Mediterranean South.
- *Part III outlines a new strategic direction, grounded in territorial cooperation, institutional innovation and cultural transformation*. It proposes the Mediterranean region as a fertile ground for launching a new paradigm of sovereignty, rooted in shared infrastructures, applied education, and strategic alliances between Europe and MENA countries.

By linking sovereignty and localized SDGs, this notebook aims to support a deeper rethinking of resilience as a territorial, institutional and geopolitical asset.



What Technological Sovereignty Really Means

Redefining sovereignty in the age of global instability: the power to design, own and govern key technologies as the foundation of autonomy, resilience and global positioning

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Abstract

In an era defined by global instability, ecological urgency, and the fragility of interdependent supply chains, the concept of technological sovereignty has re-emerged as a strategic priority for the European Union and its member states. This article explores the meaning of technological sovereignty as a **systemic and territorial capacity**, embedded not only in industrial capabilities but also in institutions, culture, and knowledge infrastructures. We argue that technological sovereignty is essential for resilience, democratic autonomy, and the territorial localization of sustainability transitions. Drawing on the latest research in innovation studies, political economy, and regional development, we show that reclaiming sovereignty requires a profound reorientation of education, finance, governance, and enterprise models. It is not simply a matter of securing technologies, but of redesigning the **socio-technical systems** that enable societies to shape their own futures.

Introduction: Sovereignty Returns

The concept of sovereignty—once thought incompatible with globalization—has returned to the heart of European strategic discourse. The Strategic Technologies for Europe Platform (STEP), launched in 2023, is the EU's first coordinated effort to explicitly promote technological sovereignty as a structural objective. The European Commission defines this as *“the ability to make autonomous choices and to access and use critical technologies necessary for resilience and competitiveness”* [1].

This shift reflects a growing recognition that technological dependence—on digital platforms, rare earths, semiconductors, or medical supply chains—poses structural risks not only to economic security but to democratic governance and societal cohesion. As Scholvin and Wigell argue, *“sovereignty in the 21st century is not about isolation, but about the capacity to act deliberately within interdependence”* [2].

From Dependency to Capacity: Defining Technological Sovereignty

We define technological sovereignty as the capability of a political-territorial system to autonomously design, develop, govern, and adapt critical technologies needed for its strategic objectives. This implies:

- *Design capacity*: the ability to define problems and develop solutions through engineering, prototyping, and systems thinking.
- *Productive infrastructure*: the means to manufacture, maintain, and scale key technologies within trusted or domestic systems.
- *Institutional governance*: strategic direction through planning, regulation, and mission-oriented investment.
- *Cognitive and learning capacity*: the embedded know-how and reflexivity to evolve and improve across cycles of innovation.

As Kattel and Mazzucato note, *“sovereignty is not merely the possession of assets, but the ability to coordinate and direct innovation in line with collective missions”* [3].

Territorial Sovereignty: A Distributed Infrastructure

Technological sovereignty is not solely a national affair. It is rooted in territories, in the dense and relational infrastructure of institutions, enterprises, schools, and public agencies that enable societies to generate and govern knowledge.

Rodrik and Sabel emphasize that *“structural transformation is always place-based—it occurs where productive capabilities, governance, and learning interact”* [4]. In many European regions, however, this capacity has eroded. The dismantling of applied engineering education, regional innovation agencies, and long-term planning has led to a decoupling between production and innovation.

This is not only an economic issue, but a political one. The loss of territorial control over technological pathways weakens local democracy and exposes regions to external volatility. As Barca observes, *“effective development requires institutions that can translate global goals into local strategies”* [5].

Cultural Transformation: From Efficiency to Directionality

One of the deepest challenges of sovereignty lies in cultural transformation. For decades, development policies have prioritized short-term competitiveness, efficiency, and integration into global value chains. Local actors were trained to follow—not lead.

Reclaiming sovereignty requires a redefinition of development: not as GDP growth, but as strategic capacity-building—the ability of territories to define missions, mobilize actors, and build optionality. This shift affects:

- *Education*: strengthening technical and engineering education, and linking it to real-world design challenges.
- *Governance*: restoring anticipatory planning and cross-sectoral coordination.
- *Enterprise*: shifting from subcontracting to innovation-driven business models.
- *Innovation policy*: favouring problem-solving over publication metrics.

As Andreoni argues, *“productive development requires the co-evolution of institutions and capabilities—not just market incentives”* [6].

Finance and Risk: The Missing Infrastructure

Another structural gap is finance. Sovereignty demands long-term, patient, and risk-tolerant capital. Yet most financial systems in Europe remain geared toward short-term returns, often in low-innovation sectors like real estate or logistics.

To reverse this, regions must develop mission-oriented financial tools:

- Public development banks and innovation funds.
- Cooperative and community finance institutions.
- Guarantees for experimental, pre-commercial R&D.

Lazonick and Mazzucato insist that *“innovation ecosystems require not only scientific and productive assets, but also financial institutions that absorb uncertainty and distribute rewards collectively”* [7].

Democratizing Sovereignty

Finally, technological sovereignty is not purely technical—it is inherently political. Decisions about which technologies to develop, which risks to accept, and which futures to pursue must be made collectively, not delegated to markets or distant bureaucracies.

Schot and Steinmueller argue for a shift toward transformative innovation policy, in which “*directionality is co-constructed with civil society, regions, and users—not just imposed from above*” [8]. Sovereignty without participation is technocracy; sovereignty with inclusion becomes strategic democracy.

Conclusion: Rebuilding from the Ground Up

Technological sovereignty is not a return to protectionism. It is a forward-looking infrastructure for resilience, autonomy, and inclusive transitions. Reclaiming it requires rebuilding territorial systems that can design, produce, and govern technology in line with collective missions. This is not only an industrial challenge, but a societal transformation. It calls for new educational priorities, new financial instruments, renewed public institutions, and above all, a new vision of what development means.

Only through such a systemic and democratic approach can Europe—and its territories—regain the capacity to shape their technological and ecological futures.

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Localizing the SDGs: From Global Goals to Territorial Strategies

Turning global principles into concrete strategies: how the success of the UN 2030 Agenda depends on the capacity of territories to shape and control their technological and institutional futures.

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Abstract

While the 2030 Agenda of the United Nations sets out universal goals, its impact ultimately depends on the capacity of territories to internalize, adapt, and implement those goals within their own institutional, ecological, and productive contexts. This article examines the concept of SDG localization as an operational strategy for translating global objectives into place-based policy and governance. Drawing on the latest research in development studies, territorial governance, and sustainability transitions, we argue that successful localization is inseparable from technological sovereignty: the ability to design, adapt, and govern the systems (energy, mobility, circular economy, digital services) through which the SDGs are realized. Localization thus becomes not only a mechanism for achieving global goals but also a strategic path for regional resilience and autonomy, especially in Europe and the Mediterranean.

Introduction: The Gap Between Global Goals and Local Capacities

The 2030 Agenda, endorsed by all UN Member States, lays out 17 Sustainable Development Goals (SDGs) as a global roadmap for ending poverty, protecting the planet, and ensuring peace and prosperity. But nearly a decade into implementation, progress is uneven, fragmented, and often disconnected from territorial realities.

As the UNDP has emphasized, *“localizing the SDGs requires a whole-of-government and whole-of-society approach”* [1]. The concept of localization emerged to bridge the implementation gap by anchoring global goals in territorial strategies, institutional systems, and community-level action.

However, as the OECD notes, *“cities and regions play a fundamental role in promoting a paradigm shift towards prosperity for all, yet many lack the capacity and resources to do so”* [2].

What Localization Really Means

Localization is not simply about awareness campaigns or translating UN goals into local languages. It involves the structural integration of the SDGs into local development systems.

As UN-Habitat defines it: *“Localization is the process of defining, implementing, and monitoring strategies at the local level for achieving global, national and subnational sustainable development targets”* [3].

Key components include:

- **Territorial diagnosis:** understanding how global challenges manifest locally.
- **Policy integration:** embedding SDG targets into regional and urban planning.
- **Technological enablement:** building or adapting infrastructures to meet sustainability goals.
- **Multilevel governance:** ensuring coherence across institutions.
- **Monitoring systems:** developing localized indicators and learning frameworks.

Localization is thus a planning and governance challenge, not just an agenda-setting exercise.

Why Technological Sovereignty Is Critical

Most SDGs involve technologically intensive systems: energy (SDG 7), industry and infrastructure (SDG 9), cities (SDG 11), water (SDG 6), climate (SDG 13), and circular economy (SDG 12).

Without territorial capacity to govern these technologies, localization is impossible. As Schot and Steinmueller argue, *“transformative innovation systems must be grounded in local problem-solving, not abstract indicators”* [4].

Examples:

- Local energy transitions depend on the ability to manage smart grids and renewable sources.
- Urban climate plans rely on integrated data systems, transportation design, and predictive analytics.
- Circular economies need territorial logistics, product redesign, and waste valorization.

Localization demands not just infrastructure deployment, but design capacity—what we define as territorial technological sovereignty.

The Political Economy of Localization

Localization is not a technocratic task; it is a redistributive and political process. It reconfigures power over development decisions and resources. As Andrés Rodríguez-Pose has shown, *“territorial inequality is driven less by market failure than by a lack of institutions capable of translating local knowledge into effective policy”* [5].

Effective localization requires:

- Empowering regional and local governments with strategic planning mandates.
- Rebuilding public agencies capable of coordination and foresight.
- Facilitating cross-sector collaboration between urban, industrial, and ecological domains.

The European Committee of the Regions states: *“Localizing the SDGs offers a powerful opportunity to reconnect institutions with communities and restore democratic trust at the subnational level”* [6].

SDGs as Instruments of Territorial Sovereignty

Beyond their normative value, the SDGs can serve as frameworks for strategic autonomy. They provide a global mandate that justifies investment in local capacity-building, infrastructure, and institutional renewal.

For regions in Europe and the MENA area—often peripheral in global value chains—localization becomes a path to regain agency and shape development trajectories from within. As Zuber et al. argue, *“SDG localization must be operationalized through place-based missions that combine technological experimentation, social innovation, and citizen engagement”* [7].

Conclusion

Localizing the SDGs is not an add-on—it is the key to making them real. But to succeed, regions must have the capacity to govern, adapt, and co-design the technologies and systems involved. This article has argued that SDG localization is inseparable from technological sovereignty. Without the power to prototype and control enabling systems, sustainable development remains aspirational. In the Euro-Mediterranean context, localization should be elevated from a reporting tool to a strategic pillar of policy. It can drive resilience, reduce dependencies, and build a new model of territorial governance—one rooted in capacity, cooperation, and mission-driven transformation.

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STEP and the New European Strategy

STEP as Europe's long-overdue response to technological dependence. How the programme opens a strategic window — and why it may not be enough without structural reform.

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Abstract

The Strategic Technologies for Europe Platform (STEP), launched by the European Commission in 2023, represents the EU's first attempt to consolidate funding for critical technologies and reduce external dependencies. This article analyzes STEP as a strategic inflection point: a long-delayed recognition of Europe's technological vulnerability, and a policy experiment in reshaping sovereignty through financial coordination. However, we argue that STEP, in its current form, is not a game-changer unless it is matched by structural reforms at institutional, educational, and territorial levels. Drawing on recent EU policy analyses, innovation studies, and geopolitical assessments, we explore the scope, limitations, and potential pathways of STEP as a tool for sovereign capacity building.

Introduction: Europe's Moment of Reckoning

Technological sovereignty has emerged as a defining theme in the European Union's post-pandemic strategy. The fragility exposed by supply chain disruptions, semiconductor shortages, and digital dependencies has triggered a policy reorientation. As stated in the European Commission's 2023 communication: "Technological sovereignty is the capacity to act autonomously in key areas of strategic importance. This is essential for Europe's security, competitiveness, and democratic stability" [1].

The launch of STEP—the Strategic Technologies for Europe Platform—reflects this shift. Designed as a central funding mechanism to support critical technologies, STEP aims to pool and streamline resources from multiple EU programs (Horizon Europe, InvestEU, Recovery and Resilience Facility, Digital Europe, etc.), channeling them into key sectors such as semiconductors, AI, quantum computing, clean tech, and biotech.

Yet the programme is as much a symptom as it is a solution: a reactive measure after decades of policy fragmentation and industrial delocalization.

Understanding STEP: Objectives and Design

STEP is intended to address four major gaps:

- **Coordination gap:** fragmented R&D and industrial policy across member states.
- **Investment gap:** insufficient funding for scaling strategic technologies.
- **Sovereignty gap:** dependency on third-country technologies (e.g. US cloud platforms, Asian chips).
- **Territorial gap:** unequal access to innovation infrastructures across regions.

To respond, STEP introduces the concept of "Sovereignty Projects," defined as initiatives that contribute to "Europe's long-term strategic capacity" [2]. These projects are supported via a new Sovereignty Seal, intended to signal priority status across EU funding channels.

While this represents progress, the budgetary scope is modest. The proposed budget, spread across several years and instruments, is limited compared to US and Chinese technology funds.

As Pisani-Ferry and Zettelmeyer note, *"the STEP budget is symbolic compared to the size of the challenge"* [3].

A Late Response to Deep Dependencies

Europe's external technological dependence is not new. For over two decades, scholars and policymakers warned of:

- Digital platform dependency (US-dominated cloud and data services).
- Erosion of semiconductor manufacturing capacity.
- Weak vertical integration in energy technologies.
- Systemic underinvestment in deep tech and industrial R&D.

As early as 2013, the European Council noted the *“urgent need to reduce strategic dependencies in key sectors”* [4], but few concrete actions followed.

STEP thus represents a belated recognition of structural problems. As Mazzucato emphasizes, *“Europe suffers from a policy architecture that supports R&D but not scale-up or mission-oriented deployment”* [5].

Why STEP May Not Be Enough

While STEP addresses funding coordination, it does not resolve four critical structural deficits:

1. *Territorial fragmentation*: Innovation capacity is heavily concentrated in core regions (Germany, Benelux, Nordics), leaving Southern and Eastern Europe as peripheral implementers. Without regional empowerment, STEP risks reproducing old asymmetries.
2. *Educational and technical decline*: As Andreoni and Chang argue, “Europe has allowed its engineering and applied science base to erode, especially in regions without strong industrial policy legacies” [6].
3. *Governance inertia*: National and EU-level institutions often lack the agility to implement coordinated missions. Over-bureaucratization, slow procedures, and lack of cross-sectoral planning hinder systemic action.
4. *Mission fragmentation*: Without a coherent narrative linking green transition, digitalization, and reindustrialization to territorial development, STEP risks becoming another funding silo.

What Would Make STEP Transformative?

To become a true engine of technological sovereignty, STEP must:

- *Be grounded in territorial* innovation ecosystems, not just firms and national agencies.
- *Be linked to educational and training* reforms, especially in engineering, design, and systems integration.
- *Foster public-private institutional platforms* for mission co-creation.
- *Integrate SDG localization*, circular economy, and resilience planning into its technology roadmaps.

Conclusion: From Programme to Platform

STEP is a necessary, if delayed, initiative. It opens a window for Europe to confront its technological dependence. But to seize this opportunity, the Union must move beyond programmatic funding and engage in structural reform: educational, institutional, and territorial.

If STEP remains a technocratic coordination tool, it will deliver limited gains. But if reimagined as a platform for sovereign innovation, embedded in a multi-level governance and development agenda, it could become a turning point for Europe's strategic autonomy.

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Europe's Technological Blindspot

Fragmented governance, late awakening, and strategic vulnerability. Comparing sovereignty models (EU, US, China) and the need for territorially grounded, democratic technological governance.

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Abstract

This article examines the structural causes behind Europe’s technological vulnerability through a comparative lens. While the United States and China have pursued models of sovereign technological development rooted in central coordination and strategic investment, the European Union has followed a fragmented, market-driven trajectory that has systematically weakened its capacity to act autonomously in strategic sectors. This has led to what we define as a strategic blindspot: a chronic inability to mobilize institutional cohesion, territorial capacity, and political direction for the development and governance of key technologies. Drawing on innovation policy literature and recent geopolitical analyses, the article argues that reclaiming technological sovereignty in Europe requires more than investment—it necessitates the creation of a democratic and territorially embedded governance model aligned with SDG 16 (effective institutions) and SDG 17 (partnerships).

The Myth of the Single European Innovation System

For decades, the European Union has invested heavily in research and innovation through its flagship programs, including the Framework Programmes, Horizon Europe, and various cohesion funding instruments. Yet, as Foray and Llerena observe, Europe does not possess a unified innovation system but rather *“a mosaic of disconnected regional and national strategies”* [1]. This institutional and territorial fragmentation permeates multiple layers of governance. Coordination between EU institutions, national governments, and subnational authorities remains weak. Investment is highly concentrated in a limited number of innovation hubs, particularly in the industrial cores of Northern and Western Europe, leaving Southern and Eastern regions structurally disadvantaged. Moreover, the capacity for strategic planning and foresight is unevenly distributed across territories, with many lacking the institutional infrastructure necessary to support deployment of complex technologies.

This fragmented landscape has resulted in a *paradox*: despite high levels of scientific output, Europe struggles to convert research excellence into scalable strategic technologies. The concept of a “technological blindspot” thus captures the deeper governance failure—namely, *the EU’s inability to ensure coherent innovation trajectories that are aligned with territorial development and sovereignty goals*.

Late Awakening: From Crisis to Dependency

Several recent crises have brought this vulnerability into stark relief. The COVID-19 pandemic exposed Europe’s dependence on imported medical technologies, diagnostic tools, and pharmaceutical supply chains. The global semiconductor shortage revealed the continent’s marginal role in chip production, which accounts for less than 10% of global output. The energy shock of 2022, triggered by war and geopolitical tensions, further underscored the risks of overreliance on external infrastructure for strategic resources.

These events did not create the structural problems—they merely illuminated long-standing weaknesses. As Borrás and Edquist have argued, Europe’s innovation policy framework provides support for R&D, but lacks mechanisms to guide innovation toward systemic transformation and technological sovereignty [2].

Comparing Models of Sovereignty: United States, China, and the EU

To better understand Europe's technological lag, it is useful to contrast its governance model with those of the United States and China. The U.S. has developed a hybrid model of innovation-driven capitalism, underpinned by massive federal procurement and public investment through agencies such as DARPA, the NIH, and the Department of Defense. *Foundational technologies are incubated within public institutions and later commercialized by the private sector*, allowing the U.S. to maintain strategic autonomy through intellectual property control and innovation markets.

China, by contrast, has implemented a state-led model of developmentalism characterized by five-year plans, industrial subsidies, and heavy state participation in strategic sectors such as artificial intelligence, green technologies, and semiconductors. In this model, political directionality is embedded in innovation processes from the outset, ensuring alignment with national sovereignty objectives.

The European Union, on the other hand, operates through a multilevel system of governance that emphasizes subsidiarity and indirect coordination. Rather than directing industrial and technological transformation, it relies primarily on market incentives, cross-border collaboration, and competitive project calls. This has resulted in institutional inertia and policy fragmentation, as noted by Pianta and Lucchese, who argue that *"Europe talks about industrial sovereignty but lacks the instruments to shape its direction collectively"* [3].

The Limits of Centralized Responses

Recent policy efforts such as the EU Chips Act, the Critical Raw Materials Act, and the STEP platform (Strategic Technologies for Europe Platform) represent a shift toward a more assertive technological strategy. However, these instruments face critical structural limitations. The European Union lacks a centralized mandate for industrial policy, and its fiscal space is constrained by treaty rules and reliance on national co-financing. *Moreover, many supranational strategies fail to penetrate local innovation ecosystems, resulting in a mismatch between high-level policy intentions and on-the-ground capabilities.*

As Mariana Mazzucato warns, top-down innovation investments often fall short when they are not supported by local experimentation and mission-oriented governance structures [4].

Toward a Democratic and Territorial Model of Sovereignty

Europe cannot simply emulate the statism of China or the militarized innovation system of the United States. It must instead develop a model of sovereignty that is democratic, territorially grounded, and mission-oriented. Such a model should involve broad participation in the definition of innovation priorities, including citizens, universities, public agencies, and regional enterprises. It must also mobilize territorial capacities, ensuring that all regions—not just leading innovation hubs—can contribute to technological transformation. Finally, it should align innovation strategies with societal missions such as the green transition, care systems, and circular economy practices.

This vision resonates with the objectives of SDG 16, which calls for effective, accountable, and inclusive institutions, and SDG 17, which promotes multi-stakeholder partnerships. As Fabrizio Barca has argued, *"development must be built on place-based strategies that connect institutions, knowledge, and people"* [5].

Conclusion: From Blindspot to Strategic Direction

Europe's technological blindspot is not merely a result of insufficient investment, but of a deeper governance failure. True sovereignty demands more than rhetorical commitment or ad hoc programs. **It requires a reconfiguration of decision-making structures, funding instruments, and knowledge systems that connect territorial intelligence with collective missions.** Overcoming the current fragmentation will require a shift toward multilevel, participatory governance. Democratizing innovation—by embedding it in regional strategies and public institutions—will be essential for building shared infrastructures of resilience and autonomy. Only by abandoning technocratic fixes and embracing a systemic approach can the EU develop a truly sovereign, inclusive, and democratic innovation model.

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The Dismantling of Italy's Technological Sovereignty

From Mattei to Olivetti: how Italy's technological sovereignty was systematically decommissioned. A geopolitical case study of strategic surrender and the cost of losing design sovereignty.

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Abstract

Post-war Italy was once on a trajectory to become a sovereign technological power. Bolstered by Marshall Plan resources and guided by public institutions and visionary figures, the country developed autonomous capabilities in computing, energy, mechanical design, and industrial systems. Yet, by the end of the 20th

century, these capabilities had been dismantled. This article reconstructs the arc from autonomy to dependency: from state-led innovation to privatization, from territorial industrial development to strategic disempowerment. While the United States initially supported Italy's reconstruction, it later facilitated—directly and indirectly—the absorption of its technological capacity. The Italian case is emblematic of how liberalization, elite consensus, and geopolitical hierarchy converged to dissolve a national innovation system and subordinate it to external control.

Building Technological Sovereignty After the War

In the aftermath of World War II, Italy was both devastated and uniquely positioned to reinvent its productive system. With support from the Marshall Plan, the country developed a strong public industrial backbone. Institutions like IRI (Istituto per la Ricostruzione Industriale) and ENI (Ente Nazionale Idrocarburi) were not merely bureaucracies—they were **strategic platforms for endogenous technological development**.

Under Enrico Mattei, ENI broke with the dominance of the Western oil cartel by forging direct agreements with oil-producing countries in the Global South. These were not just trade deals; they were acts of technological diplomacy. Italy invested in refining, pipeline construction, geophysical exploration—building not only infrastructure but know-how. As Garavini observes, ***“Mattei built an alternative model of energy sovereignty that challenged the established Western order”*** [1].

At the same time, in Ivrea, Adriano Olivetti led one of the most advanced computing experiments in Europe. His company, by the late 1950s, had developed the Elea 9003, the continent's first fully transistorized computer. The project married Italian design culture with cutting-edge electronics, supported by internal research laboratories and engineers trained in-house. **For a brief moment, Italy was not only assembling, but designing the future of computation.**

From Sovereignty to Strategic Disassembly

These experiences demonstrated that technological sovereignty could be territorially embedded, socially inclusive, and geopolitically assertive. But by the 1960s, a slow reversal began. Mattei died in a suspicious plane crash in 1962. Olivetti died two years earlier, and shortly after, Olivetti's computer division was sold to General Electric. Italy's most promising computing platform—developed through public contracts and state-backed research—was effectively absorbed into the U.S. innovation system.

This was not an isolated event. It signaled the beginning of a deeper pattern: strategic disassembly. Over the following decades, Italy's industrial policy lost coherence. Public research declined. Planning agencies were weakened. Universities began to distance themselves from applied engineering and industrial partnerships. While manufacturing continued, the capacity to lead long innovation cycles eroded.

The Privatization Era: From Public Assets to Strategic Vulnerability

The 1990s marked the critical turning point. Under the direction of Mario Draghi, then Director General of the Italian Treasury, Italy launched the most extensive wave of privatizations in its post-war history. Between 1992 and 2000, companies like Telecom Italia, ENI (partially), INA, and numerous strategic subsidiaries of IRI were sold off. This process was framed as an urgent necessity to reduce public debt and comply with EU convergence criteria.

But the consequences went far beyond accounting. Italy did not just sell industrial assets—it dismantled the infrastructure of national technological sovereignty.

No new institutional architecture was created to replace the public industrial system. Research budgets declined sharply. Public agencies were hollowed out. Universities, decoupled from productive ecosystems, shifted toward academic publishing and theoretical training. The result was a collapse in process engineering capacity and in the ability to govern innovation in strategic sectors.

As Gallino warns, *“Italy ceased to act as a sovereign designer of its future. It became an implementer of trajectories defined elsewhere”* [2].

Technological Subordination in a Globalized Order

The dismantling of Italy’s industrial autonomy occurred in a geopolitical context dominated by U.S. hegemony and the rise of neoliberal orthodoxy. The Washington Consensus, disseminated through IMF, World Bank, OECD and EU policy frameworks, framed liberalization and privatization not only as economic tools, but as signs of political modernity.

In this setting, Italy’s governing elites often internalized strategic subordination as technical inevitability. While publicly endorsing sovereignty, they presided over the outsourcing of critical technologies—from computing to telecommunications, from aerospace to infrastructure.

Italy transitioned from a “system builder” to a platform for outsourced production, integrated in global value chains but excluded from upstream control. Its economy remained productive, but technologically dependent. As Andreoni and Chang have shown, *“countries that lose design and process know-how become permanently subordinate, even if they maintain industrial output”* [3].

Conclusion: Strategic Surrender or Reawakening?

Italy’s trajectory demonstrates how quickly technological sovereignty can be lost—and how difficult it is to recover. Sovereignty is not a rhetorical concept; it is an institutional, educational, and technological capacity that must be built, maintained, and defended.

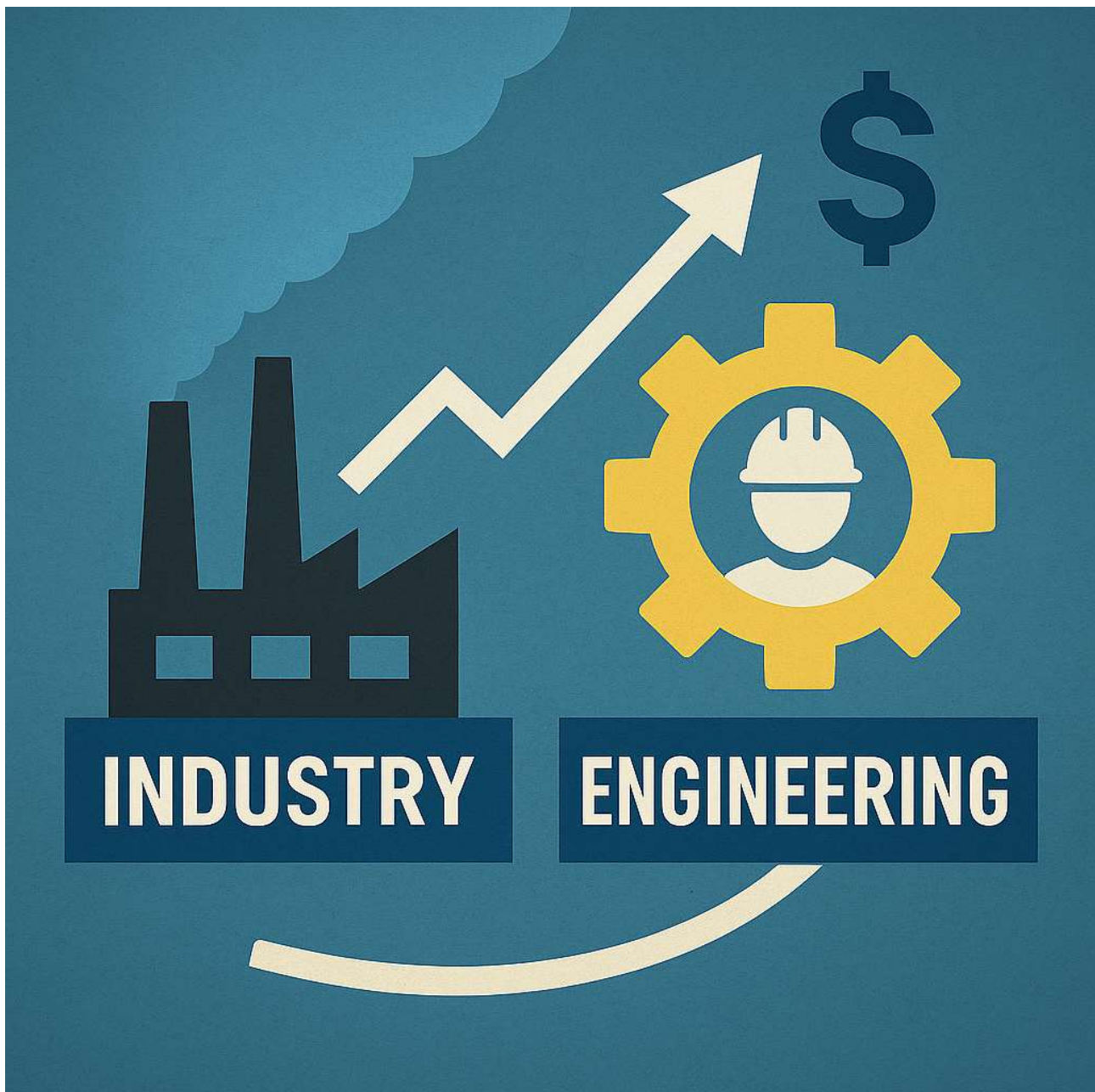
The Italian case is not just a national story—it is a warning for Europe. If a country with such industrial depth can be dismantled through policy choices and elite alignment, no system is immune. In the context of the STEP programme and the broader debate on European strategic autonomy, Italy should not only be seen as a case of decline—but as a frontline for reconstruction.

Reclaiming technological sovereignty today means rebuilding public capacity, reconnecting education to production, and linking regional knowledge to national missions. It means rejecting the logic that modernization requires dependency, and remembering that sovereignty—once lost—is never easily regained.

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How Lack of Engineering Capability Undermines Sovereignty

Why Southern European and MENA regions remain stuck in subordinate roles despite hosting major industrial assets — and how rebuilding local engineering ecosystems is key to escaping dependency.

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Abstract

Across Southern Europe and the MENA region, large-scale industrial infrastructures have been installed in regions that lack the institutional and educational capacity to design, govern, or adapt them. This article examines how this structural disconnection—between production and engineering sovereignty—has been deliberately maintained as a mechanism of dependency. Focusing on Puglia (Italy) and oil-producing MENA countries, we explore how the suppression of process engineering capabilities has prevented these territories from achieving technological autonomy, undermining their ability to transition toward sustainable and circular models. Drawing on recent academic literature and policy frameworks, we argue that reclaiming sovereignty starts with restoring the right and the capacity to design.

Industrial Development Without Technological Control

In many regions of Southern Europe, *industrial presence is used as a proxy for development*. But this assumption collapses under scrutiny. Puglia, for instance, hosts an impressive range of strategic infrastructure: from the ENI refinery and petrochemical complex in Brindisi to the ex-Ilva steelworks in Taranto, from large thermoelectric and biomass power stations to the logistics and port systems of Taranto and Brindisi. *Yet the region does not possess the engineering capacity to govern, modify, or replicate any of these systems*. There are no university programs in refinery process engineering, no specialized curricula in petrochemical systems or biochemical engineering for pharmaceutical production, despite the fact that these sectors are all physically present and economically significant.

This is not a marginal issue. It is at the core of a structural condition that Andreoni and Chang describe as “*a country’s ability to develop new industries is directly tied to its capacity to master process technologies. Without this, production can happen, but the value and control are externalized*” (Cambridge Journal of Economics, 2019). In other words, *industrial presence alone does not generate sovereignty*. That requires the knowledge systems to design and redesign.

Puglia is not unique. Across the Mezzogiorno, universities have been distanced from production systems, and engineering education has become increasingly theoretical, shaped by national academic metrics that reward publication volume rather than territorial transformation. According to Bianchi and Labory, this has led to “*a triple disconnection: between university and industry, between public investment and engineering education, and between industrial presence and process innovation*” (Industrial Policy After the Crisis, 2011).

The MENA Paradox: Oil Without Sovereignty

The same dynamic is observable in many MENA countries, particularly those rich in hydrocarbons. Saudi Arabia, Kuwait, Algeria, and Egypt collectively operate some of the most advanced oil and gas infrastructures in the world. Yet, the design, optimization, and technological governance of these systems are almost entirely outsourced. Multinational engineering firms such as Bechtel, Technip, Sinopec, and Saipem dominate the project pipeline, from feasibility studies to turnkey delivery. Domestic technical universities, although numerous, are rarely embedded in these systems, and often play marginal role in the design of national infrastructure.

As UNIDO points out, “*the absence of process engineering institutions in oil-exporting countries is not a market failure—it is a structural feature of a system designed to externalize value creation*” (Industrialization in the MENA Region, 2020). This is not simply the legacy of colonial extraction, but a contemporary logic of

control, exercised through institutional and educational dependency. Mazaheri is even more explicit: *“Natural resources generate wealth only when coupled with sovereign institutions of technological transformation. By controlling the knowledge but not the land, dominant powers maintain control over both”* (*Oil Booms and Business Busts*, 2016).

This artificial separation between resource ownership and technological autonomy is deeply geopolitical. It ensures that capital-intensive infrastructures in the global South operate under the technological supervision of global North institutions. It also reproduces a cycle in which local capacity is permanently underdeveloped—by design.

Engineering Sovereignty and the Circular Transition

The implications of this model are not only economic but environmental and developmental. Both the circular economy and the bioeconomy—key pillars of sustainability transitions—require robust process engineering capabilities. Without them, it is impossible to build systems that valorize industrial waste, convert biomass into bioproducts, or optimize closed-loop material flows. *The OECD emphasizes this clearly: “Process engineering is central to the transition towards a circular economy, as it enables the design of sustainable value chains, waste valorisation pathways, and resource-efficient production systems”* (*Policy Highlights on Circular Economy and Innovation*, 2018).

In regions like Puglia, the potential for a circular bioeconomy is enormous. Agricultural residues, wastewater, organic waste, and industrial by-products could be transformed into biofuels, biofertilizers, and green chemicals. But these resources remain underexploited, precisely because the region lacks the technical institutions and process design capacity to integrate them. The European Commission reinforces this point: *“Regions with strong engineering capabilities are better positioned to implement circular economy models tailored to their industrial structure and resource base”* (*S3 Industrial Modernisation Platform*, 2020).

The *FAO and UNEP add that “localized engineering and process innovation are prerequisites for deploying circular bio-based systems in regions lacking legacy infrastructure”* (*Global Bioeconomy Outlook*, 2021). In other words, green transitions do not happen by decree—they require embedded technical institutions capable of steering them.

Reclaiming the Right to Design

Recovering technological sovereignty in Southern and peripheral regions is not just a technical issue. It is an institutional, cultural, and geopolitical task. It begins with reterritorializing engineering education, re-establishing public design institutions, and re-embedding innovation within mission-oriented strategies.

As Schot and Kanger argue, *“transformative innovation systems require mission-oriented, territorially grounded institutions capable of steering complex socio-technical change”* (*Research Policy*, 2018). This means moving beyond fragmented funding and university rankings, and instead reconnecting knowledge production with real, place-based challenges.

The lesson is clear: without the power to design, no region can truly claim sovereignty. Industrial presence without engineering autonomy may create jobs and GDP, but it does not create resilience. Sovereignty begins with the right—and the ability—to imagine and build.

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Building a Euro-Mediterranean Technology Roadmap

How the Mediterranean Region Can Become a Sustainable Platform Through SDG Localization and Technological Sovereignty

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Abstract

The Strategic Technologies for Europe Platform (STEP), launched in 2023 by the European Commission, marks a long-overdue recognition of the European Union's structural vulnerabilities in critical technology domains. While it consolidates financial instruments to reduce dependency, this alone is insufficient to rebuild strategic capacity—particularly in the Mediterranean, where the effects of deindustrialization, educational disconnection, and territorial marginalization are most pronounced.

This article synthesizes the findings of the previous analyses and outlines a pragmatic roadmap for developing a Euro-Mediterranean technological sovereignty aligned with the Sustainable Development Goals (SDGs). Drawing from literature in innovation policy, territorial governance, and sustainability transitions, it identifies four key strategic domains: education and engineering ecosystems, territorial innovation governance, financial instruments for mission-oriented investment, and institutional mechanisms for SDG localization. The Mediterranean is repositioned not as a periphery, but as a pivotal strategic space for building shared autonomy across Europe and MENA.

Introduction: From Crisis to Strategy

The STEP program explicitly recognizes the strategic nature of technology in securing resilience, competitiveness, and democratic stability across the EU. As the European Commission puts it, “technological sovereignty is the capacity to act autonomously in key areas of strategic importance” [1]. Yet sovereignty, as this notebook has shown, cannot be bought—it must be rebuilt.

Southern Europe and the Mediterranean have suffered from a systematic weakening of the institutions required for this reconstruction. The dismantling of applied engineering education, the outsourcing of design capacities, and the fragmentation of public research have all undermined territorial autonomy. However, these same territories also contain the infrastructure, human capital, and geopolitical relevance needed for a strategic reconfiguration.

The Euro-Mediterranean: From Passive Periphery to Strategic Platform

The Mediterranean has long served as an industrial platform, but not a sovereign one. Italy's privatization wave, driven by elite consensus and international pressure, hollowed out the public institutions that once enabled design autonomy [2]. In MENA, the dominance of foreign engineering firms in oil and infrastructure projects reflects what UNIDO calls a “structural disconnection between natural resources and technological capability” [3].

Rather than viewing these cases as isolated, they should be understood as different expressions of a broader pattern of technological disempowerment. The solution is not national retrenchment, but a cooperative re-territorialization of sovereignty: building new capacities through shared, mission-oriented platforms that align technological development with sustainability and resilience.

A Roadmap for Euro-Mediterranean Sovereignty

- 1) **Rebuilding Engineering Capacity through Mission-Oriented Education:** The foundation of any technological sovereignty lies in education—specifically, in reconstituting regional process engineering and system design schools that respond to local productive structures and sustainability goals. As Andreoni and Chang argue, “technological learning requires the co-evolution of capabilities and institutions” [4]. Curricula must be co-designed by regional authorities, universities, and industry, focused on sectors where sovereign capacity is needed: refining, renewable energy, water reuse, bioeconomy, and circular manufacturing. This will close the disconnect between academic output and strategic needs, as documented in regions like Puglia and the oil-producing MENA [5][6].
- 2) **Embedding Innovation in Territorial Governance:** Technological transformation cannot be governed only from the EU level. As Barca notes, “territorial development must be built on institutions capable of aligning regional knowledge, goals, and actors” [7]. STEP and related EU programmes should therefore mandate regional implementation roadmaps, co-developed by local governments, universities, and public research centers. These roadmaps must define clear missions (e.g. green steel, zero-waste pharma, low-carbon ports) and allocate coordination roles to institutions with the capacity to execute them.
- 3) **Mobilizing Strategic Finance for Sovereignty Transitions:** Innovation without finance cannot scale. As Lazonick and Mazzucato emphasize, “sovereign innovation requires patient capital and collective risk-sharing mechanisms” [8]. Yet, across much of the Euro-Mediterranean region, financial systems remain ill-equipped to support long-term, technology-intensive development. Short-termism, risk aversion, and weak territorial investment channels hinder the ability of public and private actors to sustain missions that require years of experimentation, piloting, and adaptation. What is needed is not merely more capital, but a reorientation of financial logic: from speculative returns to strategic value; from individual projects to systemic capability-building. Sovereignty transitions must be supported by financial instruments capable of absorbing uncertainty, aligning incentives with public missions, and enabling institutional learning. This includes coordinated action across public development banks, local investment networks, and innovation agencies. Without this financial transformation, even the most well-designed educational and institutional reforms risk stalling. Mobilizing mission-oriented finance is thus an essential pillar in the roadmap toward Euro-Mediterranean technological sovereignty.
- 4) **Operationalizing SDG Localization as Strategic Governance:** The SDGs offer not only targets but institutional legitimacy for investing in regional capacity. As the OECD and Committee of the Regions stress, “localizing the SDGs is essential to reconnect global agendas with community realities” [9][10]. Localization must become a planning methodology: embedding SDG-linked missions into climate action plans, industrial reconversion, and digital infrastructure deployment. Regional authorities should be trained and resourced to translate SDGs into place-based development strategies, measured through custom indicators and iterative learning.

Conclusion: A New Compact for Shared Sovereignty

The Mediterranean is not destined to remain a subordinate industrial zone. With targeted educational, institutional, and financial reforms, it can become a strategic bridge between Europe and the Global South, capable of designing, governing, and exporting technological solutions aligned with the SDGs.

This roadmap is not utopian. Each step builds on existing evidence and precedents: regional innovation systems (RIS3), mission-oriented funding, cooperative engineering schools, and territorial planning frameworks. But to succeed, it requires political commitment, coordinated governance, and a reframing of sovereignty not as control—but as shared capacity.

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