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IPCEIs on the move: the Hy2Tech project from an Italian perspective

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Abstract

Anchored in the European Union's Fit for 55 agenda, hydrogen is a key lever for decarbonizing "hard-to-abate" industries and heavy transport. This crucial role and novelty make hydrogen an interesting case to examine. In this respect, this thesis, after outlining hydrogen production routes ("green", "blue", "grey") and demand outlook to 2050, will focus on a specific European industrial policy tool – Important Projects of Common European Interest (hereinafter also "IPCEIs") – and analyse its application to hydrogen. More specifically, the case study of the "Hy2Tech" project (the first IPCEI developed in the field of hydrogen) will focus on governance architecture, funding mechanisms, and technology fields. The specific perspective will be on Italy, reconstructing the functioning of the national notification strategy, the mobilization of resources through the "IPCEI Fund", and their interplay with the Italian National Recovery and Resilience Plan (hereinafter also "NRRP") measures dedicated to hydrogen, as well as mapping the participation of Italian companies and the expected impacts on supply chains, employment, and innovation. Drawing on official EU and national documentation, corporate sources, and interviews with policymakers, the thesis provides an in-depth analysis of the functioning of IPCEIs through the Hy2Tech case, assessing the strategic relevance of this model—its procedures and governance—for the future of EU industrial policy.

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Chapter 1 – Introduction

1.1 The European context: hydrogen's central role in the energy transition

When the European Climate Law entered into force on 29 July 2021, it did something more than register the Union's 2050 climate neutrality objective in the Official Journal. As a matter of fact, Regulation (EU) 2021/1119 turned a political aspiration into a binding commitment for all Member States to become carbon-neutral by 2050.[1] Moreover, it also codified the central vision of the European Green Deal – launched in 2019 as the paramount EU growth strategy – setting a roadmap to transform the Union into a modern, resource-efficient, and competitive economy aligned with climate neutrality. This legal shift created, in turn, a structural change in EU policymaking, with climate neutrality becoming an established principle of European governance that, in turn, influenced the content of various pieces of legislation in every sector of EU policy: energy, industry, transport, agriculture, and trade.[2]

From 2021 onwards, any new EU legislation has needed to be compatible with the 2050 climate target. This has influenced the architecture of major follow-up initiatives such as the Fit for 55 package, which outlines how to reduce net emissions by at least 55% by 2030 compared to 1990 levels [3]; the Save Energy Plan, announced in 2022 to boost energy efficiency [4]; and the Net-Zero Industry Act, adopted in 2023, which aims to upscale Europe's clean-tech manufacturing capacity.[5]

In this general context, hydrogen has rapidly moved from being a marginal industrial input to becoming a strategic energy carrier. As a matter of fact, while historically used mostly in oil refining and fertilizer production, hydrogen is now considered crucial for decarbonizing "hard-to-abate" sectors – such as steel, cement, chemicals, and long-haul transport – where direct electrification is technologically unfeasible or economically inefficient.[6]

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[1] European Union, *Regulation (EU) 2021/1119 of the European Parliament and of the Council establishing the framework for achieving climate neutrality (European Climate Law)*, *Official Journal of the European Union* L 243 (31 May 2021), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119.

[2] Joan Hereu-Morales, Alba Segarra, and César Valderrama, "The European (Green?) Deal: A Systematic Analysis of Environmental Sustainability," *Sustainable Development* 32, no. 1 (2024): 647–61, https://doi.org/10.1002/sd.2671

[3] European Commission, *Fit for 55: Delivering on the proposals*, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal/fit-55-delivering-proposals_en.

[4] European Commission, *Communication COM (2022) 240 final: EU 'Save Energy'*, 18 May 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022DC0240.

[5] European Union, *Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724*, *Official Journal of the European Union* L 1735 (28 June 2024), http://data.europa.eu/eli/reg/2024/1735/oj

[6] European Commission, *A Hydrogen Strategy for a Climate-Neutral Europe* (Brussels: European Commission, 2020),

Some clear legal turning points can be traced, reflecting this new centrality of hydrogen.

In July 2020, the European Commission launched the *Hydrogen Strategy for a Climate-Neutral Europe,* setting the goal of installing at least 40 gigawatts (GW) of renewable electrolyser capacity, which at the time stood at just 250 megawatts.[7]

The relevance of hydrogen was then reinforced by the recalled Fit for 55 package, which revised the Renewable Energy Directive (RED II). Under this revision, Member States shall ensure that renewable fuels of non-biological origins (RFNBOs) – which include mainly green hydrogen – account for at least 2.6% of energy used in industry and 5.7% in transport by 2030.[8]

Following this, the full-scale invasion of Ukraine by Russia on 24 February 2022 was a geopolitical shock that further accelerated the European Union's energy-policy reorientation. In response, on 18 May 2022 the European Commission released the REPowerEU Plan – an umbrella initiative launched by a Commission Communication on 18 May 2022 and implemented through amendments to the Recovery and Resilience Facility (adding REPowerEU chapters and new grants) and operational measures such as joint gas purchasing – a set of measures aimed at ending the Union's reliance on Russian fossil fuels well before 2030 and accelerating clean-energy transition.[9]

Yet the value chain of hydrogen – from the production of electrolysers to pipelines, underground storage, mobility, and industrial use – is extremely complex and prone to market coordination failures. In response to this situation, hydrogen has become one of the areas where IPCEIs have found significant scope for application as a tool for directing public investment into strategic hydrogen infrastructure.[10] More specifically, to date, four IPCEIs have been dedicated to hydrogen – Hy2Tech (15 July 2022), Hy2Use (21 September 2022), Hy2Infra (15 February 2024) and Hy2Move (28 May 2024).[11]

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https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf.

[7] Ibid.

[8] European Parliament and Council, *Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001 as regards the promotion of energy from renewable sources*, *Official Journal of the European Union* L 241 (31 October 2023): 1, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023L2413

[9] European Commission, *REPowerEU* (Brussels: European Commission, 2023.), https://commission.europa.eu/topics/energy/repowereu_en.

[10] European Commission, *Communication from the Commission on criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of Important Projects of Common European Interest*, C(2021) 8481 final (Brussels, 25 November 2021), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021XC0308(01)

[11] European Commission, *IPCEI Hydrogen Observatory*, European Hydrogen Observatory (Brussels: European Commission, accessed 2025), https://ipcei.observatory.clean-hydrogen.europa.eu

Nevertheless, the solidity of this legal and industrial framework should not obscure the political uncertainties that accompany it. Recent debates have revealed how difficult it has become for the Union to maintain a united front on climate neutrality. Member States remain divided between those advocating higher ambition and others calling for greater flexibility to safeguard competitiveness. [12]These tensions confirm that, although climate neutrality by 2050 is enshrined in law, its realization cannot be taken for granted. In this context, the role of concrete industrial instruments such as the hydrogen IPCEIs becomes even more essential: they anchor the long-term trajectory in tangible projects that are less vulnerable to short-term political oscillations.

1.2 Purpose and perspective of the thesis

This thesis delves into the design, governance, and implementation of IPCEIs and their application to hydrogen technologies – focusing on the Hy2Tech project. As a matter of fact, IPCEIs are not merely funding schemes, but rather complex institutional arrangements that require coordination between the European Commission, national governments, and private actors across multiple Member States. From the outset, the Commission has acted as a true catalyst in this process: by defining the regulatory framework, facilitating convergence among Member States, and steering the mobilisation of resources, it has transformed fragmented national initiatives into collective European undertakings. The Hy2Tech initiative therefore offers a concrete case study to examine these dynamics in action, providing insights into how shared governance and functioning mechanisms translate European strategic objectives into national implementation and industrial outcomes.

More broadly, the thesis argues that IPCEIs should also be understood as institution-builders: by requiring constant interaction across levels of government and between administrations and industry, they foster the emergence of specialised public bodies, durable administrative routines, and long-term governance capacities that extend beyond individual projects. In this sense, the analysis not only evaluate IPCEIs as instruments of industrial policy, but also interprets them as mechanisms of institutional construction, capable of reinforcing national administrations and shaping multilevel governance practices. This perspective – already evident in the hydrogen field – runs throughout the thesis and frames the conclusions that will be drawn in the final chapter.

[12] At the meeting of the Environment Council held in Brussels in September 2025, ministers were unable to reach a common position on the Union's updated greenhouse gas reduction target for 2040, which also frames the EU's nationally determined contribution (NDC) to be submitted ahead of COP30. The Presidency proposed the adoption of a non-binding declaration of intent indicating a reduction range for 2035, but Member States expressed divergent views: while some advocated higher ambition in line with the Commission's draft Climate Law (90% reduction by 2040), others opposed the upper limit of the range due to competitiveness concerns.

1.3 Methodological approach

This thesis follows a qualitative, mixed-method research design, combining legal analysis, policy interpretation, and case study methodology. The aim is to investigate both the legal-institutional design and the patterns of the Hy2Tech IPCEI at the EU level, as well as its implementation in Italy.
The initial phase of this thesis adopts a doctrinal approach, which entails an examination of the primary legal texts relating to the IPCEI regime. At the heart of this analysis lies Article 107(3)(b) of the Treaty on the Functioning of the European Union, which underpins the Commission's power to authorize State aid in favour of undertakings supporting the general objectives of the European Union.[13]
The second dimension of the thesis involves understanding the IPCEI model and its multilevel governance framework. This stage entails a systematic examination of institutional outputs issued by the main EU bodies, Member States, and private actors. Such analysis examines both the legal and economic rationale underpinning the IPCEI framework and its modalities of functioning and implementation, as reflected in policy guidelines, communications, and official reports.
The third dimension of the research turns to the implementation and functioning of Hy2Tech, with a specific focus on Italy. Here, the thesis devotes particular attention to the Italian implementation of the Hy2Tech IPCEI, examining its articulation within the broader national framework for IPCEIs and its interaction with the NRRP.

1.4 Structure of the thesis

This thesis is structured into six chapters.
The first section (Chapter 2) discusses the technological, economic, and strategic context for hydrogen within the broader framework of industrial decarbonisation in the European Union. It starts by explaining the distinctions among green, blue, and grey hydrogen. The chapter also examines the European Union's main policy strategies for hydrogen. In addition to these strategies, the chapter discusses key implementation instruments, such as the European Hydrogen Bank, designed to mobilize investment and bridge financing gaps for renewable hydrogen projects.
In Chapter 3, the thesis turns to the legal and institutional framework of IPCEIs. It describes the evolution of IPCEIs from their original application to subsequent initiatives. Through this historical perspective, the chapter examines how IPCEIs have developed into a more flexible but legally demanding instrument for facilitating transnational industrial cooperation and large-scale public

[13] European Union, *Consolidated Version of the Treaty on the Functioning of the European Union*, OJ C 326, 26 October 2012, art. 107(3)(b), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12012E%2FTXT

investment within the constraints of EU State aid control.

Chapter 4 examines the concrete functioning of IPCEIs. It sets out the legal compatibility framework—eligibility, proportionality, and safeguards— before considering the procedural steps and multilevel coordination between the Commission, Member States, and participating undertakings. The chapter also situates more recent initiatives within the IPCEI framework, showing how the instrument has evolved from an exceptional derogation into a structured component of EU industrial policy.

Chapter 5 focuses on the specific Hy2Tech IPCEI. It reconstructs the governance structure of the initiative, identifying its four main technological fields:

1. the development of hydrogen generation technologies (electrolysers)
2. the advancement of fuel cell systems
3. the development of technologies for storage, transportation, and distribution, and finally
4. the deployment of technologies for end users.

More specifically, an analysis of the State aid Decision C (2022) 5158, alongside its supporting policy materials, will demonstrate how the Hy2Tech project materialises priorities set out in the various European strategies– particularly regarding projected investment levels, job creation targets, and anticipated reductions in greenhouse-gas emissions.

Chapter 6 narrows the analytical lens to the Italian context. It examines how Italy has implemented the Hy2Tech initiative, beginning with the notification submitted to the European Commission and continuing through the allocation of funds via the IPCEI Fund established under national law. The chapter also investigates the complementarity between the financing of this specific IPCEI and the NRRP. The analysis is enriched by insights from an interview with policymakers from the Ministry of Enterprises and Made in Italy (MIMIT), specifically Division V — State Aid and European and International Industrial Cooperation — of the Directorate-General for Industrial Policy, Industrial Restructuring and Crisis, Innovation, SMEs, and Made in Italy, providing a practitioner's perspective on implementation and coordination.

Finally, Chapter 7 synthesises the key findings of the thesis, showing how the IPCEI framework has evolved into a central instrument of EU industrial policy and how it operates through complex multilevel governance structures.

The thesis is complemented by a set of Annexes, which provide additional empirical material, including profiles of leading Italian undertakings, a mapping of the Italian portfolio by Technology Field, further actors engaged in the Hy2Tech context, and evidence of emerging ecosystem effects.

Chapter 2 – The role of hydrogen in Europe's industrial strategy

2.1 Hard-to-abate sectors and the potential of hydrogen

The European Union has made a clear legal commitment to become climate neutral by 2050, which entails reducing its greenhouse gas (GHG) emissions to net zero. This does not imply that all emissions will cease entirely, but that any remaining emissions must be compensated by equivalent removals (through measures such as afforestation or carbon capture technologies).

To achieve this goal, the European Commission presented the Fit for 55 legislative package in July 2021. This package includes multiple reforms aimed at reducing EU GHG emissions by at least 55% by 2030 compared to 1990 levels.[14]

Thanks to these policies, significant emissions reductions have already occurred in sectors like electricity generation, residential heating, and passenger transport. This has been made possible mainly through renewable energy, more efficient technologies, and the electrification of various uses.[15] However, several parts of the economy remain particularly resistant to decarbonisation. These are called "hard-to-abate" sectors. These sectors include certain industries where emissions are very difficult to eliminate with current technologies. This is largely because the production processes require very high temperatures or involve chemical reactions that naturally release CO_2. In other cases, the challenge lies in the lack of alternative fuels that can match the performance of fossil fuels, especially for long-distance transport.[16]

In particular, three sectors are relevant:

a) The steel sector[17]

b) The chemical industry, especially the production of ammonia[18]

[14] European Commission, "'Fit for 55': Delivering the EU's 2030 Climate Target on the Way to Climate Neutrality" (Brussels: European Commission, 2021), https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541.

[15] European Environment Agency, *Trends and Projections in Europe 2023: Tracking Progress Towards Europe's Climate and Energy Targets* (Luxembourg: Publications Office of the European Union, 2023), https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2023.

[16] IRENA Coalition for Action, *Decarbonising End-Use Sectors: Practical Insights on Green Hydrogen* (Abu Dhabi: International Renewable Energy Agency, 2021). https://acaciasustainability.com/wp-content/uploads/2021/06/IRENA_Coalition_Green_Hydrogen_2021.pdf

[17] In 2021, this industry emitted around 246 million tonnes of CO_2 - equivalent in the EU alone

[18] The standard industrial process for making ammonia, known as the Haber-Bosch process, requires large volumes of hydrogen. Today, this hydrogen is usually produced from fossil fuels, making the entire process very carbon intensive. According to the International Energy Agency (IEA), switching to a low-carbon hydrogen alternative could cut emissions from European ammonia production by up to 18 million tonnes of CO_2 per year.

c) Heavy transport – including long-haul trucking.[19]

These hard-to-abate sectors present a structural challenge to the EU's climate goals. Although recent European debates have cast doubt on the strength of political commitment to climate neutrality, the strategic role of hydrogen in addressing these challenges remains uncontested. In this context, hydrogen – used not only as a fuel but also as an essential input in industrial processes – offers a promising alternative.[20] It allows industries to adopt low-emission methods where electrification is either impossible or insufficient. For this reason, hydrogen has become a central component of the EU's broader industrial and climate strategy. In the next section, we will examine the different types of hydrogen and the implications of each production method.

2.2 Green, blue and grey hydrogen: technologies, costs and impacts

Hydrogen is a gas that can be used both as an energy carrier and as a chemical feedstock. Although its chemical composition is always the same, the method used to produce hydrogen determines its environmental impact, its economic cost, and the technological challenges involved. To make these differences easier to understand, experts and policymakers often use a colour-based system. Among the many colour labels used, the three most important are grey, blue, and green hydrogen, as they dominate current discussions on energy transition and climate policy:

a) "Grey hydrogen" denotes hydrogen generated from fossil feedstocks through processes like steam methane reforming, with no accompanying carbon-capture or emission-reduction measures.[21]

b) "Blue hydrogen" is also based on fossil fuels but includes carbon capture technologies to prevent some of the CO_2 from entering the atmosphere. [22]

[19] Heavy transport another sector where standard electrification is not always viable. Battery-powered trucks often struggle to match the driving range, load capacity, and fast refuelling needed for commercial logistics. Hydrogen-powered trucks, which use fuel cells to generate electricity on board, can offer much longer ranges and fast refuelling. For instance, the EU-funded H2Haul project demonstrated that hydrogen trucks can travel up to 600 kilometres and be refuelled in just 10 to 15 minutes.

[20] International Energy Agency, *The Future of Hydrogen: Seizing Today's Opportunities* (Paris: International Energy Agency, 2019), https://www.iea.org/reports/the-future-of-hydrogen.

[21] Grey hydrogen is currently the most widely used, both globally and in the EU. Producing 1 kg via steam methane reforming (SMR) emits about 9.3 kg of CO_2, including emissions from extraction and transport of natural gas. For this reason, grey hydrogen is increasingly considered incompatible with the EU's 2050 climate neutrality target.

[22] Blue hydrogen follows the same SMR process but adds carbon capture and storage (CCS). Its environmental value depends on capture efficiency and methane leakage during gas extraction and transport. According to the European Commission, lifecycle emissions can be cut by 55–80% compared to grey hydrogen, depending on CCS performance and methane control

c) "Green hydrogen" is produced using renewable electricity and does not generate CO_2 emissions. [23]

2.3 European Policies: EU Hydrogen Strategy, REPowerEU, European Hydrogen Bank

Hydrogen has, therefore, emerged as a central pillar of the European Union's broader strategy to achieve climate neutrality, promote industrial competitiveness, and secure its energy system against geopolitical risks. Recognising this strategic potential, the European Commission has introduced a comprehensive policy architecture.

Three initiatives are of particular relevance, in this respect:

a) the 2020 EU Hydrogen Strategy
b) the 2022 REPowerEU Plan
c) The 2023 launch of the European Hydrogen Bank.

a) The EU Hydrogen Strategy, formally adopted on 8 July 2020, marked the first time hydrogen was positioned by the European Commission as a "cornerstone" of a climate-neutral Europe. Officially published as a Communication titled *A Hydrogen Strategy for a Climate-Neutral Europe*, the document lays out a phased approach for scaling up the production, distribution, and use of renewable – or green – hydrogen.[24] This phased approach is divided into three distinct time horizons.

1. The first phase, covering the years 2020 to 2024, focuses on the creation of an initial hydrogen market. It aims to produce up to one million tonnes of green hydrogen per year.
2. The second phase, from 2025 to 2030, shifts toward market expansion and infrastructure development. The Commission set a target of 40 GW of electrolyser capacity installed within the EU, with a corresponding annual production of up to ten million tonnes of renewable hydrogen.
3. The third and final phase, starting in 2030, anticipates full market integration, in which hydrogen will become a key energy carrier in all sectors – including aviation, maritime transport, district heating, and seasonal electricity storage – facilitating deep decarbonisation and system balancing.[25]

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[23] Green hydrogen is produced by electrolysis powered by renewables, with no CO_2 emissions, making it the only option fully aligned with EU climate neutrality goals. However, in 2025 it remains the most expensive (€4.2/kg), due to high electrolyser and electricity costs. Prices are expected to drop significantly, potentially reaching €2.1/kg by 2030 with cheaper renewables and economies of scale

[24] European Commission, 2020. *A Hydrogen Strategy for a Climate-Neutral Europe*. Brussels: European Commission. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0301).

[25] Ibid.

The Strategy also introduces a governance framework for market coordination. A key element in this respect is the establishment of the European Clean Hydrogen Alliance, a stakeholder platform that brings together more than 1,500 organisations from industry, academia, civil society, and public authorities. The Alliance serves to identify investment-ready projects, standardize permitting procedures, and align the value chain from electrolyser manufacturing to end-use technologies.[26]
In parallel, the Commission integrates existing EU funding programmes, including Horizon Europe for research and innovation, the Innovation Fund for low-carbon technologies, and the Connecting Europe Facility for infrastructure.

b) In early 2022, the EU's long-standing reliance on imported fossil fuels – particularly natural gas, nearly 40 percent of which originated from Russia – was laid bare by the Russian Federation's full-scale invasion of Ukraine on 24 February. In direct response to this geopolitical vulnerability, on 18 May 2022, the European Commission unveiled the REPowerEU Plan, aimed at rapidly reducing dependency on Russian energy supplies and accelerating the Union's transition to resilient, low-carbon energy systems. This plan dramatically increases the EU's hydrogen ambition, doubling the target of ten million tonnes of renewable hydrogen consumption – outlined in the 2020 strategy. This revised target comprises two equal components: ten million tonnes to be produced domestically within the Union, and ten million tonnes to be imported from third countries, mainly from North Africa, Ukraine, and the Middle East. As to the production target, REPowerEU proposes legal reforms to accelerate project deployment. These include:
   - the prioritization of hydrogen infrastructure under the revised Trans-European Energy Networks for Energy (TEN-E) Regulation[27]
   - the simplification of permitting processes, and
   - the encouragement of Member States to dedicate part of their NRRPs – funded through the NextGenerationEU programme – to hydrogen-related investments.[28]
c) Given that cost remains a significant hurdle for scaling renewable hydrogen, the Commission adopted initiatives also in this respect.[29] In response to this situation, President Ursula von der

[26] European Commission. *European Clean Hydrogen Alliance*. Single Market, Industry, Entrepreneurship and SMEs—Industrial Alliances. Brussels: European Commission. https://single-market-economy.ec.europa.eu/industry/industrial-alliances/european-clean-hydrogen-alliance_en

[27] Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on Guidelines for Trans-European Energy Infrastructure, OJ L 152, 3 June 2022, pp. 45–102, EUR-Lex, https://eur-lex.europa.eu/eli/reg/2022/869/oj/eng

[28] European Commission, *REPowerEU*, *Energy* (Brussels: European Commission), https://commission.europa.eu/topics/energy/repowereu_en.

[29] International Energy Agency, *Global Hydrogen Review 2022* (Paris: International Energy Agency,

Leyen announced in her 2022 State of the Union the creation of a "European Hydrogen Bank", a financial instrument intended to bridge the economic gap between green and grey hydrogen.[30] The European Hydrogen Bank, officially launched in 2023, operates through a contracts-for-difference (CfD) mechanism. This system guarantees green hydrogen producers a fixed premium over ten years, covering the difference between the cost of producing renewable hydrogen and the market price of fossil-based hydrogen. This provides producers with price certainty, reduces investor risk, and makes early-stage projects financially viable. [31][32]

The EU Hydrogen Strategy, the REPowerEU Plan, together with the European Hydrogen Bank represent a unified but adaptable framework for establishing a competitive and sustainable hydrogen economy. Each initiative targets a different dimension of the challenge, with the Strategy providing the long-term roadmap; REPowerEU introducing geopolitical urgency and funding flexibility; and the Hydrogen Bank acting as a market stimulus tool. Together, they reflect a systemic approach to transforming hydrogen from a niche industrial gas into a backbone of Europe's green industrial transformation, setting the context to see how IPCEI are called to contribute to this development.

2022), https://www.iea.org/reports/global-hydrogen-review-2022

[30] European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the European Hydrogen Bank*, COM (2023) 156 final (Brussels, 16 March 2023), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023DC0156.

[31] Ibid.

[32] The first auction under the Hydrogen Bank was held in late 2023 and awarded €800 million in funding from the EU Innovation Fund. The auction was significantly oversubscribed, demonstrating strong private sector interest. Winning bidders received premiums of up to €4.50 per kilogram of hydrogen produced, helping to cover operating costs and scale up deployment. The second auction mechanism, focusing on hydrogen imports and derivates such as green ammonia, methanol, and synthetic fuels, was launched on 3 December 2024, expanding the geographical scope of the Hydrogen Bank and reinforcing the EU's ambition to become a global hub for renewable hydrogen trade.

Chapter 3 – IPCEIs as an instrument of European industrial policy

3.1 Origins and rationale: from market integration to open strategic autonomy

Taking a small step back, the development of Important Projects of Common European Interest must be situated within the broader context of European integration.

Since the founding of the European Economic Community in 1957, competition rules have been at the heart of the integration process. Article 107(1) of the Treaty on the Functioning of the European Union (TFEU), in particular, enshrined the principle that State aid that distorts competition and affects trade between Member States is incompatible with the internal market.[33] The intention of the Treaty founders was clear: economic growth and cohesion would flow from liberalisation and integration, and, most importantly, national governments should refrain from interventionist industrial strategies that could undermine the "level playing field" within the common market.

Yet, this restrictive interpretation gradually came under strain, particularly in the aftermath of repeated crises.

In a first phase, the global financial crisis of 2008 and the Eurozone sovereign debt crisis of 2010 exposed deep vulnerabilities in Europe's industrial fabric. These shocks highlighted structural dependencies – from reliance on imported energy to the limited European footprint in strategic technologies such as semiconductors, advanced batteries, and renewable energy infrastructures.

Parallel to these crises, global industrial policy underwent a major transformation. The United States, China, South Korea, and Japan adopted increasingly assertive strategies, channeling massive public subsidies into critical sectors such as semiconductors, cloud computing, artificial intelligence, and hydrogen.[34]

In this context, European policymakers gradually realised that an exclusively liberal approach – grounded in non-interventionism and internal competition – risked leaving the Union technologically dependent and fragile in the face of global shocks. The competitive pressure exerted by the United States, China, and other strategic actors, as well as the growing centrality of "critical technologies" and the green transition, made it clear that the EU needed new instruments – among them the IPCEIs – to safeguard its technological and industrial sovereignty.[35]

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[33] Consolidated Version of the Treaty on the Functioning of the European Union (2012), C 326 (26 October 2012), PDF format, Official Journal of the European Union (OJ C 326/47), https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12012E/TXT:en:PDF.

[34] For example, the U.S. CHIPS and Science Act of 2022 alone mobilised more than $52 billion in subsidies to attract domestic semiconductor investment.

[35] Luuk Molthof and Luc Köbben. *How to 'Open' Strategic Autonomy: Policy Brief*. The Hague: Clingendael Institute, October 2022. https://www.clingendael.org/sites/default/files/2022-

As a matter of fact, the legal basis for IPCEIs was established in the 2014 IPCEI Communication, where the Commission codified specific compatibility criteria based on Article 107(3)(b) TFEU, which explicitly foresaw the possibility of State aid to Important Projects of Common European Interest.[36]

This marked the formal birth of the instrument, thus allowing Member States to jointly support large cross-border projects with major spillovers in research, innovation, and first industrial deployment.[37] Rather than being confined to national or regional interventions, IPCEIs are, as a matter of fact, designed to sustain large, integrated, cross-border projects capable of generating systemic European benefits, addressing market failures that deter private investment—arising from risk, uncertainty, or the pre-competitive nature of the technology—while ensuring that public funding delivers genuine financial additionality rather than crowding out private capital.[38]

3.2 Early IPCEIs as proofs of concept

The first application of the IPCEI framework was made in the field of transport infrastructure, with the Øresund fixed link between Denmark and Sweden and the Fehmarn Belt tunnel between Denmark and Germany. Both projects were initially recognised by the Commission as IPCEIs, but subsequent legal challenges before the General Court cast uncertainty over their status and delayed final confirmation.[39] These early experiences in the field of infrastructure—characterised more by procedural disputes than by tangible industrial demonstration effects—paved the way for a clearer and more decisive breakthrough in 2018 with the approval of the Microelectronics IPCEI.

10/Policy_brief_How_to_open_Strategic_Autonomy_0.pdf.

[36] European Commission. *Communication from the Commission — Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest*. Official Journal of the European Union, C 188/2, June 20, 2014. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0620(01).

[37] Helena Gräf, "A Regulatory-Developmental Turn Within EU Industrial Policy? The Case of the Battery IPCEIs," *Politics and Governance* 12 (2024), https://doi.org/10.17645/pag.8188.

[38] Olimpia Fontana and Simone Vannuccini, *How to Institutionalise European Industrial Policy (for Strategic Autonomy and the Green Transition)*, LEAP Working Paper 7/2024 (Turin/Paris: LEAP – Luiss Hub for New Industrial Policy, March 8, 2024), Research Paper, Centro Studi sul Federalismo (CSF), ISBN 979-12-80969-12-5, https://leap.luiss.it/wp-content/uploads/2024/03/WP7.24-How-to-institutionalise-European-industrial-policy-.pdf

[39] In the Øresund case, the Commission's approval of State aid was partially annulled on procedural grounds, leading to a new investigation. In February 2024, the Commission concluded that the joint Danish-Swedish state guarantee did not constitute new aid, while certain Danish tax measures amounted to incompatible aid to be recovered (Decision C (2024) 959). This decision is currently under review before the General Court (case T-258/24). By contrast, the Fehmarn Belt project was reaffirmed as an IPCEI in a new 2020 decision, after the Commission had revisited its assessment. Competing ferry operators (including Scandlines and Stena Line) challenged this outcome, but in February 2024 the General Court dismissed their actions (cases T-364/20 and T-390/20), thereby consolidating the project's legal position.

Led by France, Germany, Italy, and the United Kingdom, this project targeted strategically critical technologies such as sensors, semiconductors, power electronics, and embedded software.[40]With €1.75 billion in authorised State aid, the initiative represented a crucial test of the Commission's willingness to allow large-scale, coordinated, and cross-border interventions under Article 107(3)(b).[41]

The first IPCEI catalysed the launch of further initiatives.

As a matter of fact, in 2019 and 2021, two major projects in the battery value chain were authorised: the IPCEI on Batteries (2019) and the European Battery Innovation – EuBatIn (2021). Together, they involved a total of 12 Member States and more than 40 companies. These IPCEIs aimed to construct a complete European ecosystem for batteries – from raw material extraction and processing to cell production, recycling, and second-life applications. Together, they mobilised nearly €6 billion in public funding and attracted more than €14 billion in private investment.[42]

The Battery IPCEIs directly addressed Europe's structural dependence on imported battery cells, particularly from Asian suppliers, at a time when more than 90% of global cell production was concentrated outside the EU. This reliance represented a strategic vulnerability for Europe's industrial base, especially given the accelerating global shift towards electric mobility. With the rapid expansion of the electric vehicle market, securing domestic production capacity of advanced batteries became essential not only to safeguard the competitiveness of the European automotive sector, but also to ensure technological sovereignty in a field critical for the green and digital transitions.

Against this background, the two IPCEIs in the battery value chain were designed to foster a fully-fledged European battery value chain, from raw material processing to cell manufacturing and recycling, thereby reducing dependence on imports and positioning Europe at the forefront of next-generation energy storage technologies.

In addition to their industrial objectives, these projects illustrated the institutional logic of the IPCEI framework. First, they provided a European platform for the construction of integrated value chains,

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[40] European Commission, *Approved IPCEIs in the Microelectronics Value Chain*, *Important Projects of Common European Interest (IPCEI)*, Competition Policy (Brussels: European Commission), https://competition-policy.ec.europa.eu/state-aid/ipcei/approved-ipceis/microelectronics-value-chain_en.

[41] European Commission, "State Aid: Commission Approves Plan by France, Germany, Italy and the UK to Give €1.75 Billion Public Support to Joint Research and Innovation Project in Microelectronics," press release IP/18/6862 (Brussels, December 18, 2018), *European Commission Press Corner*, https://europa.eu/rapid/press-release_IP-18-6862_en.htm.europa.eu

[42] European Commission, *Approved IPCEIs in the Batteries Value Chain*, *Important Projects of Common European Interest (IPCEI)*, Competition Policy (Brussels: European Commission), https://competition-policy.ec.europa.eu/state-aid/ipcei/approved-ipceis/batteries-value-chain_en

where no single Member State could alone master the entire technological cycle. Second, they generated enforceable obligations for knowledge diffusion: companies receiving aid were required to disseminate non-confidential research results to SMEs, universities, and research institutions. Third, they reflected the principle of "financial additionality", ensuring that public funds reduced investment risk while attracting rather than displacing private capital.[43]

3.3 The 2021 IPCEI Communication

After these first years of adoption, a regulatory change was needed. In this respect, the 2021 IPCEI Communication codifies this "institutional logic" into compatibility tests—importance/common interest; integration; incentive effect; proportionality; spillovers; limited distortions—and attached horizontal safeguards (transparency/publication, anti-cumulation, separate analytical accounts, possible clawbacks) to preserve the level playing field.

Published on 25 November 2021 and entering into force on 1 January 2022, the revised Communication replaced the 2014 framework. Compared to the earlier version, and in line with a public discourse more oriented towards "strategic autonomy", the 2021 Communication aligns more closely with the Union's overarching policy priorities, such as the Green Deal, the Digital Strategy, the New Industrial Strategy, the EU Health Union, and NextGenerationEU.

More specifically, some innovations can be highlighted:

a) A more open and inclusive nature of IPCEIs, as all Member States must be given a genuine opportunity to participate, with approval requiring the involvement of at least four of them.
b) The particular emphasis on the participation of start-ups and SMEs, introducing specific conditions in the compatibility assessment to lower entry barriers for smaller actors.[44]
c) Further adjustments concerned the flexibility of financing. In the future, different funding sources—both EU and national—may be combined, provided that the total aid does not exceed the most favourable rate.
d) Project-specific clarifications are also introduced: infrastructure projects must guarantee non-discriminatory network access, while First Industrial Deployment projects must involve genuinely innovative processes rather than routine technical upgrades. At the same time, the

[43] Alberto Boronat, "IPCEI: A Market Design Tool for Pro-Competitive Industrial Policies in Europe?" *Journal of European Competition Law & Practice* 15, no. 7 (2024): 526–536, https://doi.org/10.1093/jeclap/lpae074.

[44] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

Commission signals stricter scrutiny of potential distortions, making clear that aid linked to the relocation of activities from other EEA countries will normally be considered incompatible with the internal market.[45]

e) Finally, the revised framework underscores the Commission's discretion to require recovery mechanisms to ensure proportionality, thereby reinforcing the principle that State aid should remain strictly limited to what is necessary.[46]

3.4 Political consolidation and strategic positioning of IPCEIs

Crucially, the political significance of IPCEIs grew in parallel with their operational success. The European Council explicitly recognised them as a "valuable instrument of European industrial policy", stressing their role in addressing significant market failures and in promoting projects that exceedthe capacities of individual Member States. Moreover, the Council called for the continuous optimisation of the IPCEI framework to rationalise and accelerate the process and to facilitate participation by firms of all sizes.[47] This political endorsement elevated IPCEIs from a niche legal instrument to a flagship policy mechanism at the core of EU industrial strategy.

It is precisely in this political dimension that the rationale of IPCEIs has been most powerfully reframed. High-level policy reports such as the Letta Report and the Draghi Report of 2024 have gone further, presenting IPCEIs as potential "backbone mechanisms" of Europe's new economic strategy. More specifically, the Letta Report *(Much More than a Market)* underscored their ability to pool resources and create economies of scale in sectors where Europe risks lagging behind.[48]

Along similar lines, the Draghi Report *(The future of European competitiveness)* which contains more than 50 references to IPCEIs, outlined an ambitious roadmap to extend them beyond innovation-intensive sectors, proposing new IPCEIs for cross-border infrastructure, zero-emission aviation,

45 Ibid.

46 European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

47 Council of the European Union, *Competitiveness Council (Internal Market and Industry), 24 May 2024*, meeting page, Council of the European Union, https://www.consilium.europa.eu/en/meetings/compet/2024/05/24

48 Enrico Letta, *Much More Than a Market – Speed, Security, Solidarity: Empowering the Single Market to Deliver a Sustainable Future and Prosperity for All EU Citizens*, report presented to the European Council (Brussels, April 2024), 147 pp., https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf.

defence industries, and even a dedicated "IPCEI for competitiveness"[49] supported by a fast-track procedure and a European budget line.[50]

As a further proof of their political relevance, the thinking behind these proposals resonated immediately within the institutional discourse of the Union. In her Political Guidelines 2024-2029, Commission President Ursula von der Leyen identified IPCEIs as one of the possible objectives of the forthcoming "European Competitiveness Fund", emphasising that "Europe can use its collective strength to invest together in ambitious common projects – as it has already done with batteries, hydrogen, and microelectronics" and committing to make the framework "simpler and faster to get financed and off the ground"[51]. These commitments have been translated into legislative and programmatic initiatives such as the Competitiveness Compass (January 2025)[52], the Clean Industry Pact[53] (February 2025), and the Mid-term Review of Cohesion Policy (April 2025)[54], all of which explicitly expand the scope and financing possibilities of IPCEIs.[55]

Academic and policy debates have further reinforced this political turn. Scholars have framed IPCEIs as "market design tools" that allow the EU to reconcile competition law with proactive industrial strategies.[56] Others have highlighted their "continued popularity" and their growing capacity to

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[49] Gian Paolo Manzella, *Gli IPCEI come modello di politica industriale europea*, *Federalismi.it* no. 20/2025 (July 30, 2025): 28 pp., https://www.astrid-online.it/static/upload/protected/manz/manzella_fed_20_25.pdf.

[50] Most recently, in August 2025, Mario Draghi stressed that to achieve the necessary technological scale and economic self-sufficiency, the European Union should advance through new forms of integration, such as agreements on Important Projects of Common European Interest, and, above all, common financing. He reiterated the urgency of implementing IPCEIs by advocating "common debt" to fund large-scale European initiatives in defence, energy infrastructure, and disruptive technologies that fragmented national efforts alone cannot deliver.

[51] European Commission, *Political Guidelines for the Next European Commission 2024–2029*, presented by Ursula von der Leyen (Strasbourg, 18 July 2024), https://commission.europa.eu/document/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en

[52] European Commission, *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions on A Competitiveness Compass for the EU (COM (2025) 30 final)* (Brussels, 29 January 2025), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025DC0030.

[53] European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on The Clean Industrial Deal: A Joint Roadmap for Competitiveness and Decarbonisation* (COM (2025) 85 final) (Brussels, 26 February 2025), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025DC0085.

[54] European Commission, *Communication from the Commission to the European Parliament and the Council on A Modernised Cohesion Policy: The Mid-Term Review* (COM (2025) 163 final) (Strasbourg, 1 April 2025), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025DC0163.

[55] Gian Paolo Manzella, *Gli IPCEI come modello di politica industriale europea*, *Federalismi.it* no. 20/2025 (July 30, 2025): 28 pp., https://www.astrid-online.it/static/upload/protected/manz/manzella_fed_20_25.pdf.

[56] Alberto Boronat, "IPCEI: A Market Design Tool for Pro-Competitive Industrial Policies in Europe?" *Journal of European Competition Law & Practice* 15, no. 7 (2024): 526–536, https://doi.org/10.1093/jeclap/lpae074.

institutionalise cross-border collaboration as a permanent feature of European governance[57]. Still others interpret them as a paradigmatic expression of the EU's attempt to institutionalise a model of industrial policy consistent with strategic autonomy and the green transition.[58]

By 2025, therefore, IPCEIs had become more than funding instruments: they embody the institutionalisation of a European developmental model. They illustrate the conviction that competitiveness in the twenty-first century requires coordinated, large-scale, and mission-oriented investment strategies. They also demonstrate that the EU can move beyond its traditional market-based orthodoxy towards a new form of industrial governance, where competition law is reconciled with strategic policy goals in a structured yet flexible way. In this sense, IPCEIs stand today as emblematic vehicles for the Union's broader project of economic sovereignty, resilience, and sustainable growth.

Chapter 4. The concrete functioning of ICPEIs

4.1 Legal compatibility framework

4.1.1 Eligibility and the integrated project requirement

In this context of increased attention to the instrument, the 2021 IPCEI Communication reframes eligibility around the idea of developing a single integrated European project rather than a mere sum of national schemes. [59]

Integration: To qualify for an IPCEI, participating Member States must demonstrate *ex ante* that the notified portfolio is bound together by a common Chapeau text that sets shared objectives, milestones, and governance, and that individual sub-projects are complementary and interdependent in

[57] Andreas Eisl, *EU Industrial Policy in the Making: From Ad Hoc Exercises to Key Instrument — How to Make IPCEIs Fit for the Long Run*, Policy Paper No 286 (Paris: Institut Jacques Delors, December 16 2022), https://institutdelors.eu/content/uploads/2025/04/PP286_EU-industrial-policy-in-the-making_Eisl_EN.pdf.

[58] Olimpia Fontana and Simone Vannuccini, *How to Institutionalise European Industrial Policy (for Strategic Autonomy and the Green Transition)*, LEAP Working Paper 7/2024 (Turin/Paris: LEAP – Luiss Hub for New Industrial Policy, March 8, 2024), Research Paper, Centro Studi sul Federalismo (CSF), ISBN 979-12-80969-12-5, https://leap.luiss.it/wp-content/uploads/2024/03/WP7.24-How-to-institutionalise-European-industrial-policy-.pdf

[59] As clarified in the 2021 Communication (para. 22–24), Member States must demonstrate that their national measures form part of "one integrated project of common European interest". The Commission stresses that simple parallelism of national schemes is insufficient: integration must be evidenced through concrete linkages—technological complementarities, coordinated timelines, and cross-border spillovers—so that the value of the whole exceeds the sum of its national parts.

technological content, timing, and expected outputs. Crucially, involving more than one Member State is a necessary but insufficient condition: the decisive test is whether the package functions as one project—i.e., whether the value of the whole exceeds the sum of national parts because of designed cross-border complementarities and planned spillovers.[60]In particular, integration must be evidenced with concrete artefacts, not asserted in general terms. The Commission expects the existence of a coherent programme narrative, a mapping of technological linkages and sequential dependencies across national sub-projects, a coordinated calendar of work packages and decision points, and a governance scheme that can steer the project as a whole. In practice, Member States submit a portfolio-level logic that shows how upstream research feeds joint demonstrators or shared testbeds, how validation protocols travel across borders, and how standardisation work or open facilities will diffuse capabilities to non-participants. This complex evidentiary bundle is what allows the Commission to treat the notified measures as a single project of "common European interest" rather than as parallel national aid.[61]

Spillovers: Positive spillovers are part of eligibility, not an *ex post* aspiration. In this respect, portfolios must specify structured collaborations (intra- and cross-country), dissemination channels (non-confidential results made publicly available), and access modalities for SMEs and research and technology organisations (RTOs)—for example, through open days, shared testing lines, or fair, reasonable, and non-discriminatory (FRAND) access where compatible with intellectual property strategies. By tying aid to these diffusion mechanisms, the framework converts "European added value" into a set of verifiable obligations that extend benefits beyond direct beneficiaries and hosting Member States.[62]

Scope: The Communication also clarifies scope as part of eligibility. IPCEIs may cover Research & Development & Innovation (R&D&I) and, under strict conditions, First Industrial Deployment (FID) when an installation or production line is genuinely first-of-a-kind and still characterised by technological and market risk—i.e., where coordination failures and uncertainty remain too high for

[60] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

[61] Ibid.

[62] Ibid.

private financing alone. By contrast, routine roll-out and commercial expansion are excluded and should rely on other instruments. This delimitation preserves the internal market while concentrating public risk-sharing where it is most justified by uncertainty and indivisibilities.[63]

4.1.2 Proportionality: funding gap, eligible costs, and clawbacks

The principle of proportionality in IPCEIs is implemented through a set of mechanisms that ensure public support remains limited to what is strictly necessary.

Funding gap: Financing proportionality in IPCEIs is not a qualitative judgement but a quantified exercise centred on the "funding-gap" method. It is therefore expected that beneficiaries submit discounted cash-flow (DCF) models comparing the with-aid scenario to a credible counterfactual in which the project would not occur—or would occur at a smaller scope, scale, or speed—absent aid. The difference in the net present value (NPV) or internal rate of return (IRR) between these two scenarios, benchmarked to an external weighted average cost of capital (WACC), delimits the minimum necessary aid. In short, State support is capped by the demonstrable investment shortfall arising from uncertainty, indivisibilities, and coordination failures, rather than by nominal intensity ceilings.[64]

The counterfactual analysis is carried out very attentively: undertakings are expected to document realistic alternatives—postponement, relocation, downsizing, or technological downgrades—and to justify the choice of parameters (volumes, prices, utilisation, ramp-up, learning effects) through internal evidence and external comparators. The WACC must be grounded in market data and reflect the project's risk profile, not the firm's balance-sheet average. Sensitivity analyses (e.g., capex overruns, demand shocks, input cost shifts) demonstrate robustness and guard against optimistic bias. These modelling norms convert proportionality into an audit-ready artefact rather than an aspirational concept.[65]

Eligible costs: Eligible costs mirror the R&D&I taxonomy but add a tightly circumscribed window for FID. On the R&D&I side, eligible items include personnel, instruments and equipment (depreciation or use), buildings and land (to the proportion used), contractual research, knowledge and patents, and additional overheads directly attributable to the project. On the FID side, eligibility

[63] Ibid.

[64] Ibid.

[65] Ibid.

is restricted to first-of-a-kind assets and processes—pilot lines, validation environments, pre-series tooling—to the extent they remain exposed to significant technological and market risk. Routine roll-out, commercial capacity expansion, and standard refuelling infrastructure do not qualify. This draws a legal line between uncertainty-bearing industrialisation (eligible) and ordinary market deployment (ineligible)[66].

Moreover, to avoid cross-subsidisation, the Communication requires separate analytical accounts for the IPCEI projects, enabling *ex post* verification that costs and revenues have been correctly allocated and that aid neither leaks into non-eligible activities nor exceeds the closing funding gap. Publication duties (via the State aid register and national portals) reinforce discipline by enabling peer and public scrutiny of awards, parameters, and beneficiaries.

Clawback mechanism: Where actual profitability materially exceeds *ex ante* projections, clawback mechanisms align realised aid with the original funding gap. These may take the form of *ex post* aid reductions, profit-sharing above agreed thresholds, or reimbursement triggers linked to outperformance. Clawbacks are particularly salient for larger tickets and FID components, where upside variance can be significant. They preserve neutrality *ex post* without dulling the *ex ante* incentive effect. [67]

Additional proportionality safeguards: Two additional proportionality safeguards complete the toolkit:

a) Member States must demonstrate that IPCEI aid does not stack with other national or EU sources for the same eligible costs beyond compatibility limits; where complementary funding is present (e.g., EIB finance or EU programmes), the combined package must respect the minimum-necessary principle.

b) operating aid is generally excluded; the instrument targets risk-bearing investment (R&D&I and first-of-a-kind industrial steps), not ongoing cost support. Together, these guardrails keep IPCEIs focused on correcting market failures while limiting distortions.[68]

4.1.3 Safeguards: transparency, sustainability, and SME/RTO access

In addition to proportionality, the IPCEI framework embeds a series of safeguards that ensure

[66] Ibid.

[67] Ibid.

[68] Ibid.

public support delivers broader benefits while remaining aligned with EU policy priorities.

Transparency: Transparency is a constitutive element of IPCEI compatibility, meaning that disclosure is a core condition for approval. Member States must publish essential award information in the Commission's State aid register and, where applicable, on national portals, including beneficiary identity, project description, aid instrument, eligible costs, and aid amount. Publication enables peer scrutiny, supports *ex post* evaluation, and—crucially—disciplines proportionality by exposing funding-gap assumptions to public view. The 2021 Communication elevates these disclosure duties from good practice to compatibility conditions: where transparency is not ensured, the Commission cannot verify minimum-necessary aid or assess cumulative funding, and compatibility is put at risk.[69]

Sustainability: Sustainability is mainstreamed through explicit references to resource efficiency, circularity, and the avoidance or reduction of critical raw materials. While IPCEIs are not an environmental aid regime, the 2021 framework requires applicants to demonstrate how project design mitigates environmental externalities across the life cycle—e.g., through material substitution (reduced use of scarce/critical inputs), recyclability/reuse of components, and improved energy/material efficiency in pilot lines. This approach complements, without duplicating, the EU's Do No Significant Harm (DNSH) logic: projects are expected to avoid significant environmental harm in their design and implementation, and to reflect EU sustainability standards where relevant.[70]

Access for SMEs and RTOs: Access for SMEs and RTOs is a core diffusion lever. The Communication requires that IPCEIs generate positive spillovers beyond direct participants via:

a) non-confidential dissemination of results
b) structured collaborations and open events
c) fair access to shared infrastructures (testing lines, validation facilities) on transparent terms, including, where compatible with IP strategy, FRAND-type access conditions.

The objective is to ensure that public investment in frontier assets—pilot lines, demonstrators, pre-series tooling—translates into ecosystem-wide capability building rather than enclave benefits for large incumbents. [71]

[69] Ibid.

[70] Ibid.

[71] Ibid.

4.2 Procedures and multilevel coordination

The transformation of IPCEIs into a central pillar of European industrial policy has not only been the result of political will and strategic necessity, but also of the establishment of a detailed and carefully structured procedural framework. This framework has evolved progressively since the adoption of the first Communication in 2014, with the 2021 revision bringing the IPCEI regime to maturity. As a matter of fact, the new Communication reflected lessons learned from the microelectronics and the first battery IPCEIs, and it substantially expanded the procedural safeguards, sustainability requirements, and transparency obligations. Importantly, it introduced a clearer articulation of the procedural phases through which an IPCEI has to pass, thereby institutionalising what had been, in the early projects, largely improvised coordination among Member States and Commission services.[72]

4.2.1 The IPCEIs procedural steps

The implementation of an IPCEI follows a structured sequence of procedural steps, from the earliest exchanges among Member States and firms to the Commission's final compatibility decision.

The Forum phase: The procedural pathway of an IPCEI begins in an informal but decisive setting: the Joint European Forum on IPCEIs (JEF-IPCEI). Created by the Commission as a dedicated platform to coordinate Member States and industrial actors, the Forum functions as a hybrid governance space where technical administrations, representatives of ministries, and industry stakeholders exchange preliminary ideas. In practice, the earliest phase of an IPCEI can be described as a pre-political stage, in which a specific Member State, often motivated by industrial priorities at the national level, proposes the launch of a project idea within the Forum[73]. At this early stage, the Forum mainly serves to clarify methodological tools, share initial experiences, and test the viability of potential projects. A fuller analysis of the Forum's institutional set-up, functions, and recent outputs is provided in section 4.2.3, which examines its broader role in the governance of IPCEIs.

[72] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(01)

[73] European Commission, *Joint European Forum for IPCEI (JEF-IPCEI)*, *Important Projects of Common European Interest (IPCEI)*, Competition Policy (Brussels: European Commission), https://competition-policy.ec.europa.eu/state-aid/ipcei/joint-european-forum-ipcei_en. —

The initial phase: Once sufficient consensus has been reached in the Forum, this initial phase concludes with the communication, within the Forum, by the Member States concerned of their support for a given IPCEI.

The design phase and the role of the Coordinating Member State: Then, the project enters what may be termed the "design phase". Here, a working group is formally established, usually with the appointment of a Coordinating Member State[74]. This role is of a particular institutional importance: the Coordinating State assumes the responsibility of steering the project, maintaining communication with the Commission, and ensuring that other Member States are kept informed and have the opportunity to join. The Coordinating State must also set a concrete calendar of milestones, ensuring that the project evolves within the timeframes compatible with the Commission's review processes. In practice, this stage is where the scattered ambitions of different national industries and governments begin to coalesce into a coherent European project. In operational terms, the Coordinating State acts as a *primus inter pares,* dedicating sufficient administrative capacity and budget, promotes collaboration (including matchmaking among potential participants), and manages expectations by clarifying that IPCEIs are neither a blanket exemption from State-aid rules nor the only funding route.[75]

The national phase: Once the working group and the Coordinating Member State have been appointed, the process intensifies at the national level. Each participating Member State launches open calls for expressions of interest directed at firms, research centres, and consortia operating in the relevant sector.[76] These national calls serve a dual institutional purpose. On the one hand, they ensure that the principle of transparency is respected, granting broad access to the opportunity to join a European flagship project. On the other hand, they allow each Member State to identify those undertakings that are most suitable in terms of technological expertise, financial capacity, and strategic alignment with both national industrial policy and EU-level priorities. Such calls have become a defining feature of the IPCEI framework, in contrast to ordinary State aid procedures,

[74] Gian Paolo Manzella, *Gli IPCEI come modello di politica industriale europea*, *Federalismi.it* no. 20/2025 (July 30, 2025): 28 pp., https://www.astrid-online.it/static/upload/protected/manz/manzella_fed_20_25.pdf.

[75] Luuk Schmitz, Timo Seidl, and Tobias Wuttke, "The Costs of Conditionality: IPCEIs and the Constrained Politics of EU Industrial Policy," *Competition & Change* (February 2025), https://doi.org/10.1177/10245294251320675.

[76] Ibid.

because they institutionalise a bottom-up dimension in what is otherwise a top-down European project design.

At the same time, the design phase obliges Member States to start aligning their national priorities with European strategic objectives. The working group and the Coordinating Member State must consult with the Commission services – principally DG COMP, but also DG GROW and DG ENER in the case of energy-related projects – to test the project's overall coherence with EU priorities.

At this stage, competition among firms within each Member State is complemented by incentives to form consortia and collaborative ventures. In fact, the Commission has repeatedly stressed that IPCEIs are meant not only to advance frontier technologies but also to foster industrial ecosystems characterised by cooperation between large firms, SMEs, and research institutions. The 2021 Communication explicitly added the criterion that IPCEIs should promote the inclusion of SMEs as direct participants or as beneficiaries of knowledge diffusion obligations imposed on larger participants. This institutional emphasis has proven particularly relevant in sectors such as batteries, semiconductors, and hydrogen, where industrial development is heavily dependent on supply-chain integration and where SMEs can contribute niche innovations that enhance overall system performance.[77]

The matchmaking phase: Once national selection processes are concluded, the initiative enters the European "matchmaking phase". Here, the individual projects identified at the national level are brought together into a coherent European framework. This integration is not only technical but also legal: the Commission requires that IPCEIs demonstrate strong complementarities between the different initiatives in order to comply with the integration requirements among the different projects[78].The matchmaking stage is where the European dimension of IPCEIs becomes most tangible. Administrations and firms from different Member States must coordinate investment calendars, align technological priorities, and establish governance structures capable of ensuring the smooth implementation of the project.

[77] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

[78] Gian Paolo Manzella, *Gli IPCEI come modello di politica industriale europea*, *Federalismi.it* no. 20/2025 (July 30, 2025): 28 pp., https://www.astrid-online.it/static/upload/protected/manz/manzella_fed_20_25.pdf.

The drafting phase: Once the structure of the IPCEI has been consolidated through matchmaking, the Coordinating Member State assumes the task of preparing what is known as the Chapeau Text (in practice, drafted during the design phase and finalised after matchmaking, immediately before pre-notification). This document serves as the central narrative and legal description of the project as a whole. It is not a technical annex but a comprehensive explanation of the project's objectives, governance, financial structure, and anticipated impacts. The Chapeau synthesises the contributions of national administrations, participating firms, and research institutions into a single text that is then submitted to the Commission.[79] Its function is threefold: to demonstrate the overall coherence of the IPCEI, to highlight the European value-added in terms of cross-border spillovers, and to illustrate the proportionality of the requested State aid. In parallel, participants prepare the individual project documents – projects descriptions and funding-gap analyses – covering expected positive and negative cash flows over the project lifetime and a substantiated counterfactual scenario without aid.[80] The preparation of the Chapeau illustrates the complexity of this coordination: Member States push to underline the national relevance of their projects, undertakings seek recognition of their technological contributions, and the Commission ensures that the final document presents a unified and strategically coherent narrative. This process has been aptly described as a form of co-drafting diplomacy, where legal and political compromises are negotiated line by line. Differences in administrative capacity and financial resources can exacerbate asymmetries—wealthier Member States are often able to mobilise larger aid envelopes, while smaller ones may struggle to match their contributions—raising the risk of unequal participation. To mitigate this, the Commission has promoted broader involvement, at times requiring a minimum number of Member States for approval.[81]

The prenotification phase: After the Chapeau has been drafted and agreed among participating Member States, the procedure enters the so-called "prenotification phase", which is perhaps the most delicate step in the entire IPCEI process. Unlike other forms of State aid control, where Member States typically notify aid schemes directly, IPCEIs require an extended phase of structured dialogue between national administrations and the European Commission prior to official notification.[82] The

[79] Ibid.

[80] Luuk Schmitz, Timo Seidl, and Tobias Wuttke, "The Costs of Conditionality: IPCEIs and the Constrained Politics of EU Industrial Policy," *Competition & Change* (February 2025), https://doi.org/10.1177/10245294251320675.

[81] Andreas Eisl, *EU Industrial Policy in the Making: From Ad Hoc Exercises to a Key Instrument—How to Make IPCEIs Fit for the Long Run*, Policy Paper No. 286 (Paris: Jacques Delors Institute, December 16, 2022), https://institutdelors.eu/content/uploads/2025/04/PP286_EU-industrial-policy-in-the-making_Eisl_EN.pdf.

[82] Gian Paolo Manzella, *Gli IPCEI come modello di politica industriale europea*, *Federalismi.it* no. 20/2025 (July 30,

prenotification allows the Commission's services – primarily DG COMP, but also DG GROW, DG CONNECT, DG ENER, or others depending on the sector – to evaluate the completeness of the documentation, to raise early concerns, and to guide Member States towards compliance with the strict compatibility criteria.

This stage is unique because it institutionalises a trilateral governance dynamic between the Commission, the Member States, and the industrial participants. It is not only a dialogue between governments and Brussels: firms and consortia are often directly involved, providing detailed technical data, financial projections, and timelines for implementation. The aim is to pre-empt possible grounds for incompatibility by aligning the project narrative and evidence with the Commission's expectations. According to the 2021 Communication, prenotification is "essential to ensure legal certainty and to accelerate the formal notification stage".[83]

The formal notification phase and the Commission evaluation: Once prenotification concerns have been addressed, each participating Member State proceeds to submit its formal notification to the Commission[84]. The notification stage triggers the formal evaluation phase by the Commission, which assesses whether the IPCEI is compatible with the internal market under Article 107(3)(b) TFEU. The evaluation is extremely detailed and technical, encompassing legal, financial, economic, and strategic considerations. According to the 2021 Communication, the Commission must verify that the project represents a "clear, concrete, and identifiable contribution to the Union objective" and that it produces "positive spillovers extending beyond the borders of the Member States concerned".[85] After the Commission's decision, Member States frequently conduct additional national cost-audits to verify necessity and efficiency before disbursing funds; overall, from emergence to final disbursement, timelines commonly span about four to five years.[86]

2025): 28 pp., https://www.astrid-online.it/static/upload/protected/manz/manzella_fed_20_25.pdf.

[83] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

[84] Gian Paolo Manzella, *Gli IPCEI come modello di politica industriale europea*, *Federalismi.it* no. 20/2025 (July 30, 2025): 28 pp., https://www.astrid-online.it/static/upload/protected/manz/manzella_fed_20_25.pdf

[85] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

[86] Luuk Schmitz, Timo Seidl, and Tobias Wuttke, "The Costs of Conditionality: IPCEIs and the Constrained Politics of EU Industrial Policy," *Competition & Change* (February 2025), https://doi.org/10.1177/10245294251320675.

A central component of this evaluation is the Commission's scrutiny the funding gap analysis prepared by the participating firms. As described in the previous paragraph, the principle is that aid must be strictly limited to what is necessary to trigger the investment, without compensating for risks that would normally be borne by market operators. To this end, firms submit detailed financial models showing projected cash flows, expected costs, revenues, and rates of return with and without the aid as part of the project documents at pre-notification. Where the Commission identifies that, absent public support, the project would not reach a sufficient rate of return or would not be realised at all, the aid can be deemed compatible.[87]To safeguard proportionality, the Commission may also impose, as already indicated, "clawback mechanisms", which oblige firms to reimburse part of the aid if the project ultimately generates profits exceeding those projected in the financial analysis.[88] The rationale is to avoid overcompensation and to ensure that public funds are used efficiently. This clawback is set upfront in the Commission's approval decision and is applied *ex post* by national authorities during implementation.[89]

Therefore, the Commission is required to carry out a balancing test between the expected positive effects of the aid and its potential distortions of competition. This proportionality review involves a rigorous check that the aid is strictly limited to what is necessary and does not provide undue advantages to particular firms. If the financial analysis shows that a project could proceed without public support, the Commission will not authorise the aid. Conversely, where the risk profile and projected revenues justify intervention, aid may be approved, but with strict proportionality.

The Commission also places particular emphasis on some additional aspects:

a) Whether the IPCEI contributes to reducing Europe's dependencies in critical value chains, such as semiconductors, hydrogen, and pharmaceuticals.
b) Similarly, projects that support regional cohesion, by involving less developed regions or by fostering industrial ecosystems across multiple territories, are regarded as highly positive.[90]

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[87] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

[88] Ibid.

[89] Luuk Schmitz, Timo Seidl, and Tobias Wuttke, "The Costs of Conditionality: IPCEIs and the Constrained Politics of EU Industrial Policy," *Competition & Change* (February 2025), https://doi.org/10.1177/10245294251320675.

[90] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(02).

In this sense, IPCEIs do not only serve innovation policy, but also cohesion and strategic sovereignty objectives, reinforcing their hybrid character as instruments situated at the intersection of competition law, industrial policy, and territorial cohesion.

c) The Commission's evaluation also considers the long-term systemic impact of the project. Successful IPCEIs are expected not only to deliver direct technological outputs but also to foster enduring ecosystems of collaboration across Member States, industries, and research organisations.

d) Finally, another evaluation carried out by the Commission concerns the governance structures created for the project – such as joint ventures, research alliances, or cross-border industrial clusters – considering whether they can survive beyond the life of the funded activities. This future-oriented perspective is what makes IPCEIs different from ordinary aid schemes: they are designed not only to correct immediate failures, but also to build the institutional capacity of Europe to act collectively in strategic sectors.[91]

The final evaluation stage epitomises the dual nature of IPCEIs. On the one hand, they remain subject to the rigour of EU competition law, requiring meticulous financial justification and proportionality. On the other hand, they embody a mission-oriented approach to industrial policy, privileging cross-border collaboration, strategic autonomy, and sustainability. By the time an IPCEI is approved, it is no longer just a portfolio of national projects, but the crystallisation of the European industrial mission, legally validated and politically endorsed. After approval, national funding agreements transpose the decision (milestone-linked disbursements, separate analytical accounts, transparency/anti-cumulation, and—where relevant—clawbacks), and implementation/monitoring proceed under the agreed governance.

4.2.2 Institutional roles and governance

The governance of IPCEIs rests on a deliberately multi-layered architecture. It distributes responsibilities across the Commission, Member States, and private stakeholders, while embedding these roles in formal bodies that provide steering, oversight, and operational coordination.

The coordination architecture and the interplay between different actors: The coordination mechanisms underpinning IPCEIs represent one of the most innovative features of this policy instrument. Unlike ordinary State-aid procedures, where interaction is largely bilateral between a Member State and the European Commission, IPCEIs create a complex, multi-level governance

[91] Ibid.

architecture in which three sets of actors – the Commission, national administrations, and private stakeholders – interact continuously across all procedural stages. The result is an unprecedented institutional framework that blurs the traditional lines between regulator and regulated, between funder and beneficiary, and between national and European levels of decision-making. The European Commission plays, evidently, a pivotal role in this triangular relationship. Its primary function remains that of guardian of the Treaties, ensuring that State aid complies with Article 107 TFEU and with the detailed requirements laid down in the 2014 and 2021 IPCEI Communications. However, it must be underlined, in order to fully understand the dynamics, that different actors play different roles:

a) *The Commission*: The Commission's role goes far beyond *ex post* legality checks. As a matter of fact, from the earliest stages of ideation, Commission officials facilitate the exchange of information among Member States, provide methodological guidance, and signal strategic priorities. In doing so, they function as both arbiters of compatibility and catalysts for integration, steering national ambitions towards projects that reflect collective European interests. More specifically, within the Commission, DG COMP leads the compatibility assessment under Article 107(3)(b), while sectoral services (DG GROW, DG ENER, DG CONNECT, and others depending on the sector) contribute technical and market expertise during pre-notification and decision-making.

b) *Member States*: For the Member States, coordination entails a dual responsibility. On the one hand, they act individually by selecting national undertakings through open calls for expressions of interest, thereby ensuring transparency and compliance with the Commission's inclusiveness requirements. On the other hand, they operate collectively by pooling these national projects into a coherent European framework through matchmaking and the preparation of the Chapeau Text. The appointment of a Coordinating Member State adds a layer of leadership to this arrangement: the Coordinating Member State ensures calendar discipline, chairs cross-border working groups, integrates national inputs into the Chapeau, and acts as the primary interlocutor with the Commission.

c) *The private sector:* In the above-mentioned scheme, the private sector is not a passive recipient of aid but an active participant in the governance of IPCEIs. As outlined, firms and consortia are involved from the very first stages of ideation within the JEF- IPCEI, contribute technical data during prenotification, and participate in drafting the Chapeau Text to ensure the technological and financial coherence of the project. As a matter of fact, undertakings produce auditable evidence (credible counterfactuals and external WACC in DCF models,

sensitivity tests), granular implementation plans and technology roadmaps, structured collaboration/dissemination commitments (including SME/RTO access modalities), and maintain separate analytical accounts.

d) *The interplay*: In practical terms, this division of labour maps onto the evidence the Commission expects: Member States curate portfolios and ensure due process; undertakings deliver auditable funding-gap models, counterfactuals, and implementation roadmaps; and the Commission tests incentive effect, proportionality, and spillovers under Article 107(3)(b) TFEU. These responsibilities mirror the dossier components: the Coordinating Member State owns the Chapeau (integration narrative, milestones, governance, spillover plan); participating Member States own national project files (selection record, due-diligence, beneficiary funding-gap models); beneficiaries own financial/technical evidence and collaboration/dissemination deliverables; and the Commission owns the compatibility decision and monitoring conditions (transparency, change-control, and—where relevant—clawbacks). This mapping reduces re-work in pre-notification and anchors accountability in implementation.

The internal governance: These functional roles are embedded in a formal institutional governance set-up that structures steering, representation, and day-to-day orchestration.

a) A Supervisory Board (SB)—bringing together participating Member States (voting) and the Commission as observer—oversees delivery against joint objectives and validates KPI trees.

b) A Public Authorities Board (PAB) ensures horizontal coordination among national administrations on implementation and reporting.

c) A Facilitation Group (FG) standardises templates, consolidates technical reporting across work streams, organises the General Assembly and manages non-confidential dissemination.

d) The annual General Assembly (GA) gives voice and legitimacy by gathering all undertakings and Member States to elect chairs/field coordinators and validate membership changes, often including an open public session for external stakeholders. [92]

[92] Ibid.

4.2.3 The role of the Joint European Forum for IPCEI (JEF-IPCEI)

This cooperative nature of IPCEI is further evidenced by the crucial role played by the above-mentioned, Joint European Forum on IPCEIs which embodies the triangular coordination between the Commission, Member States, and undertakings. Established in 2023, the Forum convenes representatives of the Commission, Member States, and industry in both technical and high-level configurations.

The Forum's functions are broad: they extend from clarifying methodological issues and sharing best practices, to issuing opinions on ongoing projects and identifying new areas for potential initiatives.[93] More broadly, the Forum has been institutionalised as a permanent arena of coordination, co-chaired by DG COMP and DG GROW, and designed to reflect the Union's triangular governance logic (Commission, Member States, industry). It operates in two formations: a high-level configuration, gathering senior officials responsible for economic and industrial policy, and a technical-level configuration, comprising Member State authorities and Commission officials. Depending on the level, it meets two to four times per year, ensuring continuity across the IPCEI lifecycle. To structure its activities, the Forum is divided into four workstreams – Identification, Design, Assessment, Implementation & Evaluation – covering the entire chain from the emergence of potential projects to their monitoring and *ex post* evaluation.[94]

The Forum's remit is thus wider than mere consultation: it seeks to align IPCEIs with the objectives of the EU industrial strategy, to increase process efficiency, and to strengthen consistency across national practices. A further dimension is transparency, as the Forum is bound by Regulation 1049/2001 and regularly publishes non-confidential materials (e.g. meeting documentation and guiding notes) on the Commission's website.[95] Recent outputs confirm this evolving role: in its November 2024 opinion, the Forum highlighted new priority areas, focusing in particular on quantum technologies and the biopharmaceutical sector. This trajectory illustrates how the Forum is gradually becoming an institutional cornerstone for the governance of IPCEIs, signalling both the opportunities and constraints of Europe's industrial policy integration.

[93] For example, in its November 2024 opinion, the Forum explicitly highlighted the need to accelerate procedures, enhance SME participation, and expand IPCEIs into new sectors such as quantum technologies and biopharmaceuticals.

[94] European Commission, *Joint European Forum for Important Projects of Common European Interest (JEF-IPCEI)*, *Important Projects of Common European Interest (IPCEI)*, Competition Policy (Brussels: European Commission), https://competition-policy.ec.europa.eu/state-aid/ipcei/joint-european-forum-ipcei_en.

[95] Ibid

4.2.4 Consolidating the IPCEI framework: some recent initiatives

The institutionalisation of coordination mechanisms has been marked by several further important turning points.

The Code of good practices: adopted in May 2023, DG COMP *Code of good practices for a transparent, inclusive, faster design and assessment of IPCEIs* aims to provide more transparent, inclusive, faster design and assessment of IPCEIs.[96] This document, endorsed jointly by the European Commission and the Member States, aims to address recurring challenges observed in earlier waves of IPCEIs, such as delays in national selection procedures, limited SME participation, and fragmented reporting requirements. By compiling lessons learned from previous projects in batteries, microelectronics, and hydrogen, the Code provides a common reference framework for administrations and firms alike. It recommends, for instance, that Member States conduct open calls with clear eligibility criteria, ensure early-stage consultations with potential cross-border partners, and standardise the templates for prenotification dossiers. The Code also placed emphasis on transparency, urging both national authorities and industrial actors to disclose selection methodologies and funding allocations in a way that could be externally verified.

The National Best Practices: Building on this initial institutional structuring, in April 2025 the Joint European Forum for IPCEI, acting as the Working Group on National Best Practices, adopted the document *Collection of Recommendations on Key Priorities 1-6* which further codified practical tools such as open-call procedures, SME outreach measures, and standardised documentation templates. Together, these initiatives aim to reduce transaction costs for participants and to improve the comparability of projects across Member States.

The IPCEI Design Support Hub: finally, in continuation of this process of institutional consolidation, in April 2025 the Commission launched the IPCEI Design Support Hub, a dedicated technical body tasked with assisting both Member States and private stakeholders throughout the complex administrative life cycle of IPCEI projects. The Hub is conceived as a response to persistent feedback from administrations and companies, which had often struggled with the high transaction costs of preparing prenotification files, financial justifications, and technical annexes required for

[96] European Commission, *DG COMP Code of Good Practices for a Transparent, Inclusive, Faster Design and Assessment of Important Projects of Common European Interest (IPCEIs)* (Brussels: European Commission, 17 May 2023), https://competition-policy.ec.europa.eu/system/files/2023-05/IPCEIs_DG_COMP_code_of_good_practices.pdf.

Commission approval. Organised as a permanent unit within DG GROW, but operating in close coordination with DG COMP, the Support Hub provides methodological guidance, model documentation, and tailored advice to national coordinators and project consortia. Its functions extend to mediating in cases of overlapping national interests, streamlining the drafting of the Chapeau, and offering specialised expertise on funding-gap calculations and clawback mechanisms. The creation of this Hub thus marks a further step in the progressive institutionalisation of the IPCEI regime, moving it away from a primarily political negotiation platform towards a structured and quasi-permanent policy infrastructure.[97]

4.3 From exceptional derogation to structured policy

The analysis of the procedural architecture and the coordination mechanisms of IPCEIs shows how this instrument has progressively consolidated its place within the European industrial landscape. From the detailed examination of the various stages to the triangular governance between the Commission, Member States, and industry, it becomes evident that IPCEIs have moved well beyond their original experimental status.

It can be inferred, based on these legal and operational steps, that what was initially conceived as an exceptional derogation under State aid law has now evolved into a semi-structured model of European industrial policy. To fully grasp the implications of this transformation, it is necessary to reflect on both the broader legal and political evolution of the framework and its integration into the Union's strategic agenda.

What began in 2014 as an experimental interpretation of Article 107(3)(b) TFEU has, through successive Communications and decisions, matured into a procedural and institutional framework capable of mobilising tens of billions of euros in public and private investment across strategic sectors.[98]

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[97] European Commission, *IPCEI Design Support Hub*, *Important Projects of Common European Interest (IPCEI)*, Competition Policy (Brussels: European Commission), https://competition-policy.ec.europa.eu/state-aid/ipcei/design-support-hub_en.

[98] Between 2018 and 2023, the Commission authorised several IPCEIs in sectors such as microelectronics, batteries, hydrogen, and health. Together, these initiatives encompassed more than 335 individual sub-projects, involved 22 participating Member States, and mobilised around €37 billion in public funding, complemented by approximately €66 billion in private investment (European Commission data, 2023).
At the national participation level, France and Italy have taken part in all IPCEIs launched so far, followed by Germany and Slovakia (8 IPCEIs), Poland and Spain (7 each), the Netherlands (6), as well as Austria, Belgium, and Finland (5 each) (Table 2). Conversely, several countries have participated in only 1 or 2 IPCEIs, such as Ireland and Denmark, while Bulgaria, Cyprus, Latvia, Lithuania, and Luxembourg remain excluded from direct participation.

Table 4.1 - *Approved IPCEIs*

IPCEI	Participating companies	Projects	State aid approved (€ bn)	Expected private investments (€ bn)	Total investments (€ bn)	Participating Member States
First IPCEI on Microelectronics (2018-2025)	29	43	1.9	6.5	8.4	AT, FR, DE, IT, UK
First IPCEI on Batteries (2019-2031)	17	23	3.2	5.0	8.2	BE, FI, FR, DE, IT, PL, SE
Second IPCEI on Batteries – EuBatIn (2021-2028)	42	46	2.9	9.0	11.9	AT, BE, HR, DE, EL, ES, FI, FR, IT, PL, SK
First Hydrogen IPCEI – Hy2Tech (2022-2031)	35	41	5.4	8.8	14.2	AT, BE, CZ, EE, FI, FR, DE, EL, IT, NL, PL, PT, SK, ES
Second Hydrogen IPCEI – Hy2Use (2022-2036)	29	35	5.2	7.0	12.2	AT, BE, DK, FI, FR, DE, EL, IE, IT, NL, PL, PT, ES, SE, NO
Second IPCEI on Microelectronics & Communication Technologies (ME/CT) (2023-2032)	56	68	8.1	13.7	21.8	CZ, FI, FR, DE, EL, HU, IE, IT, MT, NL, PL, RO, SK, ES
IPCEI on Next Generation Cloud Infrastructure and Services (2023-2031)	19	19	1.2	1.4	2.6	FR, DE, IT, ES
Third Hydrogen IPCEI – Hy2Infra (2024-2029)	32	33	6.9	5.4	12.3	AT, CZ, FR, DE, EL, IT, NL, PL, PT, SK, ES
Fourth Hydrogen IPCEI – Hy2Move (2024-2031)	11	13	1.4	3.3	4.7	CZ, DE, ES, FI, FR, LV, NL, PL, SE
IPCEI Med4Cure (2024-2036)	13	14	1.0	5.9	6.9	BE, FR, HU, IT, SK, ES

IPCEI Tech4Cure (2025-2036)	10	10	0.4	0.8	1.2	FR, IT, SI
Total	**293**	**345**	**37.6**	**66.8**	**104.4**	**23 Member States, UK and Norway**

Source: European Commission, Approved IPCEIs, State Aid — Important Projects of Common European Interest (IPCEI), https://competition-policy.ec.europa.eu/state-aid/ipcei/approved-ipceis_en (Brussels: European Union, last accessed 25 September 2025).

In addition, the procedural architecture analysed above — from ideation and matchmaking to notification and evaluation — illustrates the uniqueness of IPCEIs as both legal instruments of competition law and political mechanisms for mission-oriented industrial cooperation. Yet their significance lies not only in internal governance, but also in their capacity to evolve in step with the Union's broader policy priorities. The 2019 European Green Deal, the 2022 Chips Act, and the 2023 Net Zero Industry Act all identified IPCEIs as privileged vehicles for implementing strategies that demand massive investment, technological innovation, and coordinated risk-sharing. As a result of these developments, the IPCEI regime is gradually becoming the "implementation arm" of wider industrial and sustainability agendas, bridging the gap between strategy and execution. The framework exemplifies a hybrid legal-political instrument: rooted in competition law, but oriented towards industrial transformation; national in financing, but European in logic; experimental in origin, but increasingly systemic in scope.

Chapter 5 — The Hy2Tech Case

5.1 Genesis, procedure and scope

5.1.1 From pre-notification to Decision C (2022) 5158

The Hy2Tech IPCEI - which was prenotified in three tranches on 31 August, 1 September, and 12 September 2021 – is aimed at building a European hydrogen value chain.[99] It comprises fifteen Member States—Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Italy, the Netherlands, Poland, Portugal, Slovakia, and Spain.

Preparatory phase: As an indication of the relevance of the preparatory phase in IPCEIs, between November 2021 and June 2022, the Commission services coordinated an intensive exchange of information with all participating authorities and undertakings, combining several technical meetings with three high-level meetings at senior administrative level—on 29 June 2021, 16 December 2021, and 3 June 2022—to drive convergence on scope, evidence standards, and timing. It was this preparatory phase in which the Commission and the Member States aligned the perimeter (R&D&I and FID), the structure (four Technology Fields) and the horizontal obligations (reporting, dissemination, separate analytical accounts) of the IPCEI. [100]
Furthermore, the Commission and Member States calibrated Hy2Tech's *ex ante* evidence base: Member States and undertakings provided counterfactuals, funding-gap models benchmarked to external WACC/IRR assumptions, and detailed activity plans split between R&D&I and FID.

The national phase: While Hy2Tech is a single EU programme, the national entry points were transparent and competitive. As a matter of fact, the Decision's document presents all the selection procedures that fed the EU portfolio.[101] These show that the joint Chapeau sat atop an open national framework, consistent with an EU-wide programme sourcing.

[99] European Commission. 2022. *State Aid SA.64625, SA.64642, SA.64640, SA.64633, SA.64646, SA.64632, SA.64671, SA.64647, SA.64651, SA.64644, SA.64649, SA.64626, SA.64753, SA.64635, SA.64624 (2022/N) — Important Project of Common European Interest on Hydrogen Technology (Hy2Tech), Commission Decision C(2022) 5158 final, public version.* Brussels: European Union, 15 July 2022. SA_64647_906AAD8E-0000-C3B8-A321-668C037ED53F_427_1.pdf

[100] Ibid.

[101] Ibid.

Formal notifications: the formal notifications were finalised in June 2022.[102] Each Member State individually notified its national measure together with the common Chapeau, thereby giving the Commission a single programme architecture with country-level execution tracks.[103]

Final decision and authorisation: The procedural timeline culminated on 15 July 2022, when the Commission adopted Decision C (2022) 5158 authorising up to €5.4 billion in public support, with expected private co-investment of approximately €8.8 billion, for 41 projects led by 35 direct participants across the four Technology Fields. Indeed, Hy2Tech covers the full technology chain from generation to end-use, with a pronounced mobility emphasis.

Two aspects of Hy2Tech's design deserve particular attention because they are unique to this project and shape its overall trajectory.

1. The strict definition of scope, with funding limited to research, development and innovation activities and to first industrial deployment, while excluding generic infrastructure such as hydrogen refuelling networks. This boundary was agreed early during prenotification and formalised in the Commission's decision. As a result, Hy2Tech does not function as a vehicle for general market roll-out but as an instrument for building industrial capabilities—automated production lines, integrated testing platforms, and other advanced facilities. This institutional choice reflects a deliberate policy orientation: to channel resources into creating strategic manufacturing capacity rather than subsidising widespread infrastructure deployment.
2. The integration test, procedural as much as substantive: the Decision shows that Member States designed collaborations and dissemination channels (annual public meeting; website; spillover contacts) into the programme from the start and then quantified that network density to demonstrate that Hy2Tech is an integrated project within the meaning of the IPCEI Communication.

[102] According to the Decision, Austria notified on 13 June; the Netherlands on 14 June; Greece on 15 June; Czechia on 16 June; and Belgium, Denmark, Estonia, Finland, France, Germany, Italy, Poland, Portugal, Slovakia and Spain on 17 June 2022

[103] Ibid.

Table 5.1 — *Procedural timeline of Hy2Tech*

Date	Event	Description
31 Aug–12 Sep 2021	Pre-notification	Hy2Tech prenotified in three tranches
Jun 2021 – Jun 2022	Preparatory phase	Technical & high-level meetings to align scope, perimeter, and evidence standards
Jun 2022	Formal notification	Each Member State notified its measure + common Chapeau
15 Jul 2022	Decision C (2022) 5158	Commission authorises €5.4bn State aid, €8.8bn private co-investment

Source: European Commission. Important Project of Common European Interest on Hydrogen Technology (Hy2Tech), Commission Decision C (2022) 5158 final. Brussels, July 15, 2022.

5.1.2 Objectives and scope

The final objectives and scope of Hy2Tech reflect the alignment achieved during the pre-notification phase. The Member States jointly committed to five programme-level aims:

1. To research and develop innovative and sustainable electrolysers, fuel cells and enabling components, unlocking the full technological potential of the EU hydrogen value chain.
2. To ensure the transfer of knowledge and the dissemination of results across the chain by fostering collaborations.
3. To create a cost-optimised hydrogen value chain through standardised, automated, and robust production processes.
4. To support skills formation and quality employment by strengthening highly skilled staff and mitigating the social impacts of the energy transition.
5. To coordinate hydrogen-related activities across Europe, thereby creating an integrated EU hydrogen ecosystem.[104]

As to the scope of the IPCEI, Hy2Tech is organised into four Technology Fields (TFs) that map the full value chain:

1. TF1 (hydrogen generation via electrolysis).

[104] Ibid.

2. TF2 (fuel-cell technologies).
3. TF3 (storage, transportation and distribution).
4. TF4 (end-use applications with a mobility focus).

Within and across these TFs, undertakings carry out both R&D&I and FID activities, with delineations made at project level. In this respect, the Decision stresses that Hy2Tech does not cover construction of generic infrastructure, including hydrogen refuelling stations (HRS), to maintain a tight focus on first-of-a-kind technology development and industrialisation steps; standard HRS roll-out is, by design, out of scope and addressed by other instruments or later IPCEI "waves".

In concrete terms, this perimeter means that materials science, stack/cell redesigns, new system architectures, validation and testing are in scope under R&D&I, while pilot lines, end-of-line testing concepts, and pre-series integration are in scope under FID. [105]

The R&D&I–FID coupling is central to Hy2Tech's theory of change. In this respect, the Decision indicates that:

a) TF-specific tasks begin with design and development (e.g., stack materials, bipolar plates, membranes, control systems), pass through testing and standardisation under realistic duty cycles, and culminate in pilot-line development and scale-up.
b) Lessons from R&D&I migrate into FID in the form of automated processes, embedded sensing, non-destructive testing, and data standards—so that the first industrial runs become credible references for broader replication. More generally, the Decision explicitly notes the absence of globally accepted testing and certification protocols for many hydrogen components, and therefore frames several TF deliverables as "standard-setting": common validation protocols, data collection regimes, and open interfaces that lower transaction costs for downstream users and regulators alike.[106]

5.1.3 The distribution of activities among partners

Most importantly, the Hy2Tech architecture specifies the activity mix at the level of individual undertakings.

Iveco CZ—a Czech vehicle manufacturer active across the full production chain—contributes only R&D&I activities, while Ørsted (a Danish renewable energy company), Neste (a Finnish sustainable fuels producer), and Nedstack (a Dutch fuel cell manufacturer) limit their role to First Industrial

[105] Ibid.

[106] European Commission, *Commission Decision C(2022) 5158 final, public version, § 2.2.2–§ 2.2.5* (including TF-level objectives on standardisation/testing) (Brussels: European Union, 15 July 2022)

Deployment. All other participants combine both R&D&I and FID phases.

This allocation of responsibilities reflects the different industrial starting points: some actors contribute primarily first-of-a-kind scale-up investments, bringing technologies that have already been validated into industrial production, whereas others focus on pre-competitive research still requiring substantial testing before reaching deployable scale.

It is on this basis that the Commission highlights this pattern to demonstrate that Hy2Tech is not financing either research or deployment in isolation, but rather the bridge between them—precisely the segment that private finance struggles to underwrite in nascent value chains characterised by technological and market uncertainty. By requiring different actors to specialise while also interlinking their contributions, the project creates complementarities that mirror the structure of an emerging European hydrogen ecosystem. Moreover, this deliberate mix of activities also ensures that Hy2Tech delivers both immediate industrial outputs and longer-term knowledge spillovers. In the following sections, the analysis will turn to the specific projects developed within each Technology Field, highlighting their complementarities and collective contribution to the Hy2Tech IPCEI.[107]

5.1.4 Hy2Tech as an integrated project

The Decision devotes a dedicated section to the examination of Hy2Tech as an integrated project in the specific sense of point 13 of the IPCEI Communication: a group of single projects "inserted in a common structure, roadmap or programme aiming at the same objective and based on a coherent systemic approach".[108]

The Commission's analysis shows that:

a) All 41 projects are embedded in a single programme whose objectives and value-chain architecture define a shared trajectory for the four TFs.
b) Significant added value and complementarity exist both within each TF and between TFs, detailing how upstream breakthroughs feed conversion, storage, and end-use requirements, and how operational feedback loops from mobility platforms reshape specifications for generation and storage.
c) The IPCEI develops collaboration density on an unprecedented scale (direct intra-TF, direct

[107] European Commission, *Commission Decision C (2022) 5158 final, public version, § 2.6.2* (Brussels: European Union, 15 July 2022)

[108] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(01)

inter-TF, and indirect collaborations) and pairs those network claims with institutional channels for spillovers—annual public events, a dedicated website, and dissemination obligations with SME/RTO access. [109]

In this respect, the collaboration architecture developed by different partners illustrates how complementarities operate both within and across Technology Fields. Intra-TF cooperation ensures that actors along a specific value chain—such as component developers, system integrators, and validation partners—can align their work, while cross-TF linkages connect these chains into a wider industrial ecosystem. This complementarity, which will be examined in more detail in the following sections, is what allows Hy2Tech to function as more than a collection of separate projects.

In addition, the Decision highlights a series of indirect collaborations with universities, research organisations, and SMEs, underlining that Hy2Tech extends beyond bilateral supplier–buyer ties. These examples are presented as evidence that, without programme-level coordination, such a dense and multi-layered network would not have emerged with the necessary speed and scale.[110]

It is on this basis that the Commission explicitly endorses the integrated-project qualification. It finds that Hy2Tech's individual projects and TFs are inserted into a common structure and programme, aim to achieve the same objective, and are complementary in their contribution to the important common European objective of establishing an innovative and sustainable hydrogen value chain. This conclusion is supported by the quantified collaboration network, the coherent TF architecture, and the governance system, which together supply the organisational cohesion required by the IPCEI Communication. [111]

5.2 Programme architecture

5.2.1 Technology Fields: electrolysers, fuel cells, storage/transport/distribution, end-uses (mobility)

As indicated, Hy2Tech structures its activities across four distinct Technology Fields (TF1–TF4), each reflecting a specific stage of the hydrogen value chain.

a) TF 1: The first Technology Field is devoted to hydrogen generation through electrolysis, the indispensable entry point of the entire chain. The objectives are threefold: to reduce costs and

[109] European Commission. 2022. *Commission Decision C (2022) 5158 final, public version,* §2.4; §2.4.1–§2.4.3; Table 26; and §3.3.2.1–§3.3.2.2. Brussels: European Union, 15 July 2022.

[110] European Commission. 2022. *Commission Decision C (2022) 5158 final, public version,* §2.4.3. Brussels: European Union, 15 July 2022.

[111] European Commission. 2022. *Commission Decision C (2022) 5158 final, public version,* §3.3.2.1–§3.3.2.2. Brussels: European Union, 15 July 2022.

increase efficiency, to strengthen durability and reliability, and to establish standards that make performance measurable and certifiable. A crucial challenge lies in reducing Europe's dependence on scarce and expensive raw materials such as iridium, platinum-group metals, and nickel. [112] At the same time, developers are tasked with improving cell and stack designs capable of operating under dynamic renewable inputs, and with codifying testing protocols that give investors' confidence in the bankability of electrolyser assets. Finally, the programme highlights the automation of stack production as a decisive deliverable: without scalable, cost-efficient manufacturing lines, Europe cannot reach industrial deployment at competitive costs. [113]

b) TF 2: The second Technology Field concerns fuel cells, which convert hydrogen into electricity and are critical for mobility and stationary applications. Here, the ambition is to accelerate adoption in demanding sectors such as heavy-duty transport, rail, shipping, and energy-intensive industries. Participants are expected to work across the entire chain, from advanced materials and membranes to system integration and large-scale validation. Priorities include lowering the use of platinum, developing membranes that operate at higher temperatures with reduced reliance on fluorinated compounds, and optimising stack durability. Sustainability is embedded through recycling concepts for key materials. Equally important is industrialisation: flexible and scalable pilot lines must be developed to overcome current barriers of process control and high scrap rates. Digitalisation adds another layer, with systems expected to incorporate diagnostics and predictive maintenance tools that lower operating costs and improve fleet reliability.[114]

c) TF 3: The third field addresses storage, transport, and distribution—the infrastructural backbone of the hydrogen economy. Without reliable and scalable solutions here, hydrogen cannot reach end users. Hy2Tech supports research on advanced composite vessels with improved liners, embedded sensors, and recyclability, as well as alternative storage options such as cryogenics or liquid organic carriers. Bulk storage, including underground facilities, is also explored as a necessary complement to balance renewable supply with fluctuating demand. The overall goal is to move from experimental pilots to standardised, certifiable, and

[112] European Commission. 2022. *C (2022) 5158 final, public version,* §§2.2 Brussels: European Union, 15 July 2022.

[113] European Commission. 2022. *C (2022) 5158 final, public version,* §§2.2, 2.2.2, 2.2.1. Brussels: European Union, 15 July 2022.

[114] European Commission. 2022. *C (2022) 5158 final, public version,* §§2.2, 2.2.3. Brussels: European Union, 15 July 2022.

investable products that can underpin a European hydrogen backbone. It can be summarised that objectives of TF3 are twofold:

1. To reduce reliance on costly and resource-intensive raw materials by replacing them with innovative and sustainable alternatives, while enabling recyclability across the storage value chain.
2. To improve testing, standardisation, and monitoring procedures so that safety, reliability, and interoperability are embedded in every storage and transport component.[115]

d) TF 4: The fourth field targets end-use technologies, particularly in heavy-duty road, rail, and maritime transport. It functions as the exposure mechanism of the programme, subjecting upstream innovations to demanding real-world conditions and feeding the lessons back into electrolysis, fuel cells, and storage. Activities include designing hydrogen-compatible vehicle systems, integrating fuel cells or hydrogen combustion engines, and developing testing and homologation procedures for prototypes. Rather than financing generic infrastructure, this field provides reference platforms that validate safety, durability, and reliability under operational stress.[116]

5.2.2 Participants and undertakings across Member States

What is interesting is to understand the links among the different projects in the different Technological Fields:

a) TF1: Electrolyser manufacturers are systematically coupled with materials and process specialists to move technologies such as PEM, AEL, SOE, and AEM from the laboratory to scalable manufacturing. French companies like Elogen and McPhy illustrate this duality: the former works on automating PEM stack production, while the latter builds a gigafactory for serial deployment. Similar patterns appear in Germany and Belgium, where Sunfire, John Cockerill Hydrogen, and Cummins Hydrogenics Europe each advance different electrolysis routes towards industrial maturity. Southern Member States contribute with integration and testing platforms, such as Enel Green Power in Italy and SENER in Spain. The coherence of TF1 lies in this deliberate pairing: R&D&I on advanced cells and stacks feeds directly into

[115] European Commission. 2022. *C(2022) 5158 final, public version,* §§2.2, 2.2.4. Brussels: European Union, 15 July 2022.

[116] European Commission. 2022. *C (2022) 5158 final, public version,* §§2.2, 2.2.5. Brussels: European Union, 15 July 2022.

pilot lines and gigafactories.[117]

b) TF2: A comparable logic underpinsTF2, with component innovators working hand in hand with system integrators to bring mobility applications to market. In this domain, German undertakings such as Bosch and EKPO anchor the manufacturing of heavy-duty stacks and power units, while French actors like Symbio and HYVIA target automotive integration. At the same time, companies such as Daimler Truck, Iveco, and Alstom validate these advances under real operating conditions—on heavy-duty road, bus, and rail platforms. The result is a chain that spans from material innovation to system validation. [118]

c) TF3: With reference to storage, transport, and distribution (the object of TF3), the emphasis shifts to industrialisation and monitoring. French companies like Plastic Omnium and Faurecia lead the development of composite high-pressure vessels, embedding sensing and recyclability, while Arkema supplies advanced liners. Complementary pilots address underground storage, as with NAFTA in Slovakia, or system testing, as with Enel's NextHy Lab. These projects ensure that upstream electrolysers and downstream vehicles are supported by certifiable and investable storage systems. [119]

d) TF4: Finally, in end-use applications (TF4), the programme funds prototypes that subject upstream innovations to demanding real-world conditions. Heavy-duty road applications are driven by Daimler Truck and Iveco, rail by Alstom, maritime by Fincantieri, and light-commercial fleets by HYVIA. Cross-cutting players such as Plastic Omnium and Bosch Austria contribute critical components, while systemic anchors like Ørsted or Neste link end-use pilots with power-to-X integration. [120]

It is to be noted that some undertakings appear in more than one TF—such as De Nora, Genvia, Alstom, Ørsted, Neste, and Plastic Omnium—so that progress in materials, stacks, or storage propagates beyond individual boundaries. Spillover mechanisms are also already embedded, for instance through commitments to dissemination, FRAND licensing, and access to pilot lines for

[117] IPCEI Hydrogen Observatory, "TF1 – Development of Hydrogen Generation Technologies," Clean Hydrogen Partnership (Brussels: European Union), TF1 – Development of Hydrogen Generation Technologies | IPCEI Hydrogen

[118] IPCEI Hydrogen Observatory, "TF2 – Development of Fuel Cell Technologies" Clean Hydrogen Partnership (Brussels: European Union), TF2 – Development of Fuel Cell Technologies | IPCEI Hydrogen

[119] IPCEI Hydrogen Observatory, "TF3 – Development of Technologies for Storage Transportation and Distribution" Clean Hydrogen Partnership (Brussels: European Union), TF3 – Development of Technologies for Storage, Transportation and Distribution | IPCEI Hydrogen

[120] IPCEI Hydrogen Observatory, "TF4 – Development of Technologies for End Users" Clean Hydrogen Partnership (Brussels: European Union), TF4 – Development of Technologies for End Users | IPCEI Hydrogen

SMEs and research organisations. The systemic complementarities and interdependencies across the four TFs are developed further in section 5.3.2, which sets out how they function as parts of a single integrated programme.

5.2.3 Governance and monitoring of Hy2Tech

As to the governance of Hy2Tech, the apex organ is a Supervisory Board (SB), in turn composed of a:

a) A Public Authorities Board (PAB) - one voting representative per participating Member State.
b) A Facilitation Group (FG) - Commission services attend as observers and advisers without voting rights.

As to the functions carried out by these bodies, it can be indicated that:

a) The SB provides strategic steer and accountability by agreeing key performance indicators at its first sitting, by overseeing delivery against the programme's joint objectives, and by verifying compliance with spillover and knowledge-diffusion obligations. It also bears the duty to report annually to the Commission on the basis of documentation prepared by the FG.
b) The PAB, in turn, as the public authority constituency within the SB, appears to serve as the institutional interface through which Member States feed strategic national interests into the programme and ensure that national funding agreements align with the common Chapeau and programme governance commitments.
c) The FG functions as the operational hub of the IPCEI: it standardises reporting templates across Technology Fields, coordinates cross-TF work, compiles the annual dossier for the SB, and manages the programme's public communication, including a dedicated online channel hosting non-confidential output.
d) An annual General Assembly brings together undertakings and national representatives, elects leadership roles, validates membership changes and. from the second year. is paired with a public conference to present results.

This layered constitution—steer at the Supervisory Board, orchestration by the Facilitation Group, and voice and legitimacy through the General Assembly—provides the institutional consistency required for a multi-year industrial mission under technological and market uncertainty.[121]

The public-facing layer of governance is visible in the IPCEI Hydrogen Observatory, which consolidates programme composition and provides an access point for SMEs, research organisations,

[121] European Commission. 2022. *C (2022) 5158 final, public version,* §§2.2, 2.2.5. Brussels: European Union, 15 July 2022.

and the wider ecosystem to follow dissemination activities. In this way, the governance spine turns the legal authorisation into an institutional routine where benchmarking, reporting and diffusion are scheduled, auditable, and continuously reproduce the "integrated project" claim through common documentation and transparency. [122]

As to the monitoring regime, it translates this governance architecture into operational routines. Rather than creating new institutions, it activates the existing bodies for measurement and accountability. More specifically, monitoring is organised as a three-tier system:

1. At project level, each undertaking submits annual reports to its national authority on technical progress, spillover obligations, and compliance with the DNSH principle, including links to complementary EU programmes.
2. At national level, Member States consolidate these reports into annual summaries using a common template, ensuring comparability across portfolios.
3. At programme level, the SB submits an integrated report to the Commission, assessing progress against agreed key performance indicators.

These reporting lines are synchronised with Hy2Tech's annual cycle of review and dissemination. It has to be noted that the FG ensures that data are standardised and comparable across Technology Fields, curates the evidence base for the SB's assessment, and maintains the public-facing channels through which non-confidential results are diffused. The General Assembly anchors this process by providing legitimacy, validating membership, and acting as the forum in which spillover commitments are revisited and new dissemination activities scheduled.

In this way, monitoring is not limited to administrative oversight but functions as a mechanism to safeguard proportionality, ensure transparency, and accelerate learning. Its effectiveness will ultimately determine whether Hy2Tech's technological advances can be replicated at scale in line with the Union's 2030 decarbonisation objectives.

5.3 Integration and collaboration

5.3.1 Complementarity within each Technology Field

Hy2Tech is designed so that each Technology Field functions not as a loose collection of projects, but as a coherent chain where the different phases of innovation reinforce each other. The common sequence is clear: new materials and components are developed, their performance is validated under realistic conditions, and the resulting designs are scaled up through automated pilot lines and pre-series production. In this way, every strand moves from science to manufacturability, closing the gap

[122] Clean Hydrogen Partnership. 2025. "Hy2Tech (IPCEI Hydrogen Observatory)." Brussels: Clean Hydrogen Partnership. https://ipcei.observatory.clean-hydrogen.europa.eu/hy2tech

that often separates research from industrialisation.

a) In hydrogen generation (TF1), complementarity is deliberately built into the programme. Electrolyser projects are not treated as stand-alone laboratory work, but as complete engineering pathways. Advances in electrochemistry—such as reducing the use of iridium or other precious metals—feed directly into new cell and stack designs, into improvements in thermal and water management, and into smarter control systems able to cope with fluctuating renewable inputs. These design steps are then linked to the feasibility of production: a concept only has value if it can be manufactured reliably and at scale. For this reason, the automation of stack production (from precision alignment and in-line metrology to end-of-line testing and digital traceability) is considered part of innovation itself. Finally, common validation protocols ensure that laboratory results are converted into bankable performance data, preparing the ground for certification and deployment. TF1 therefore progresses as a single chain: materials research, system design, validation, and manufacturing are advanced together rather than in isolation.[123]
b) The same logic governs the field of fuel cells (TF2). Innovations in components—new membranes, advanced gas-diffusion layers, lighter bipolar plates, durable coatings, and catalysts with reduced precious-metal content—are not developed in a vacuum. From the outset they are coupled with system integration, so that stacks are designed to withstand the heavy-duty duty cycles of trucks, buses, or trains. Industrialisation is an equally integral element: participants are expected to build flexible, scalable production lines for next-generation stacks, and to embed a digital layer of diagnostics and predictive maintenance. This combination ensures that performance, reliability, and total cost of ownership can be measured, demonstrated, and improved over time. The complementarity in TF2 thus lies in linking materials science, manufacturing processes, and service models into one coherent industrial package.[124]
c) In TF3 (storage, transport and distribution), complementarity is built around the interplay between manufacturability and monitoring. Projects on composite high-pressure vessels, for example, are not limited to new liner materials or fibre architectures: they are designed to turn tanks into “digital assets”. Embedded sensors and structural health monitoring allow safety

[123] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.4.1, 2.4.1.1 Brussels: European Union, 15 July 2022.

[124] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.4.1, 2.4.1.2 Brussels: European Union, 15 July 2022.

and durability to be observed throughout the service life of the vessel. Production processes—faster in-line testing, tighter permeation control, recycling pathways for carbon fibres and liners—evolve in parallel, so that products are both manufacturable at scale and traceable in operation. Alongside these, TF3 supports alternative approaches such as cryogenic tanks, liquid or solid carriers, and underground storage pilots. What unites these strands is the aim of turning prototypes into repeatable, certifiable and recyclable products that can underpin a European hydrogen backbone.[125]

d) In the case of end uses (TF4), integration is itself the deliverable. Hy2Tech does not fund the generic roll-out of hydrogen infrastructure. Instead, it supports ready-to-integrate building blocks: powertrain subsystems for trucks, buses and trains, hydrogen combustion engines for heavy vehicles, and refuelling components adapted to demanding mobility platforms. These packages must be validated under real-world conditions, so that they become not one-off demonstrations but certified reference platforms. Once proven, they can be replicated by manufacturers and operators across the single market, reducing both the time and the risk of adoption.[126]

Across all four Technology Fields, the pattern is consistent: research, validation, and industrialisation advance together in a deliberate sequence. This approach ensures that Hy2Tech does not simply generate scientific knowledge, but builds the conditions for scalable and certifiable industrial capacity—the critical step where private finance is least willing to bear the risk.

5.3.2 Complementarity across Technology Fields

The strength of Hy2Tech does not lie only in the internal coherence of each Technology Field, but in the fact that the four fields are mutually conditioning: progress in one creates preconditions, specifications, and feedback for the others. This interdependence is what allows the programme to function as a systemic portfolio rather than a set of parallel tracks.

a) TF1 and TF2 – Generation and conversion: the clearest link is between electrolysers and fuel cells. Advances in TF1—such as higher purity, pressure, dynamic flexibility, or improved durability—directly set the operating envelope for TF2's chemistry and thermal-mechanical design. Validation protocols and testing data generated in TF1 also become part of the evidence base on which fuel-cell integrators rely for warranty and uptime guarantees. The

[125] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.4.1, 2.4.1.3 Brussels: European Union, 15 July 2022.

[126] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.4.1, 2.4.1.4 Brussels: European Union, 15 July 2022.

loop runs in both directions: TF2 feeds experience back into TF1, for instance on electrodes, coatings, or bipolar plates, where common materials and recycling processes strengthen circular-economy logic and reduce exposure to critical raw materials. The Commission therefore explicitly highlights shared raw-material management, component development and recycling flows as examples of cross-field complementarity.[127]

b) TF3 – The enabling backbone: storage, transport and distribution act as the infrastructural hinge of the programme. Without reliable and cost-effective storage, the outputs of TF1 and TF2 cannot operate as integrated systems, nor can they be delivered to end users. Composite vessels with embedded health monitoring, cryogenic solutions, or liquid-organic and solid-state carriers all aim to provide this backbone. Complementarity here is two-way: on the one hand, storage formats and safety regimes define how fuel-cell modules and vehicle systems (TF2 and TF4) must be packaged and controlled; on the other, operational constraints from TF4—such as refuelling cadence, pressure and flow rates, or space and weight limits—feed back into TF3, pushing towards standardised interfaces and test protocols. The Decision explicitly describes TF3 as both the enabling logistics layer for TF1 and TF2, and the responsive link to TF4.[128]

c) TF4 – Exposure and feedback: End use applications are deliberately conceived as the exposure mechanism of Hy2Tech. Heavy-duty platforms in road, rail and maritime transport impose strict requirements on hydrogen quality, duty cycles, safety and cost, and these requirements cascade upstream. TF4 therefore transmits specifications back to TF1—for example on purity thresholds or load-following dynamics—and to TF3, by defining how tanks, transfer systems and safety standards must align with vehicle architectures. At the same time, TF4 draws directly on TF2's fuel-cell advances to meet demanding targets for availability and total cost of ownership. [129]

5.3.3 Structured collaborations and positive spillovers

The integration logic of Hy2Tech is not left at the level of design principles, but is made concrete through two complementary mechanisms: structured collaborations between undertakings and formal

[127] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.4.2, 2.4.2.1, 2.4.2.2 Brussels: European Union, 15 July 2022.
[128] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.4.2, 2.4.2.3 Brussels: European Union, 15 July 2022
.
[129] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.4.2, 2.4.2.4 Brussels: European Union, 15 July 2022.

spillover commitments that extend benefits beyond the direct participants. Together, these mechanisms demonstrate that Hy2Tech is more than a collection of national projects: it is a genuinely European programme.

*Collaboration density***:** The Decision documents the extent of interlinkages with precise figures: 470 indirect collaborations, 90 direct collaborations within Technology Fields, and 115 direct collaborations across Technology Fields. TF1 and TF2 show particularly dense connections with TF4 integrators, reflecting the programme's strong mobility focus. These numbers are not decorative: they serve as a governance indicator that Hy2Tech meets the IPCEI requirement of integration and cannot be reduced to a mosaic of isolated national measures.[130]

Illustrative collaborations: The Commission also highlights named examples to show how such ties translate into concrete work. Within TF1, system houses and manufacturing specialists' partner to build serial production supply chains. Across fields, vehicle integrators work with component suppliers to adapt storage geometries and hydrogen loops to platform layouts, while stack manufacturers coordinate with storage specialists on thermal and safety interfaces. These cases are important not only technically but doctrinally: they make European value-added observable in the form of cooperative projects rather than abstract claims.[131]

Spillover commitments: Collaboration is accompanied by a structured dissemination regime that ensures results extend beyond direct beneficiaries.

a) All undertakings commit to sharing non-IP-protected results through conferences, exhibitions, public events and targeted fora, with quantified KPIs such as conference contributions, sponsored PhD/MSc positions and university chairs.
b) Participants pledge to disseminate protected knowledge through licensing consistent with competition law. Some even declare readiness to license on FRAND terms, including to competitors, if this accelerates learning and reduces costs.
c) During FID phases, undertakings commit to opening pilot and pre-series facilities for SMEs and research organisations, tackling one of the main barriers to scale-up.

[130] European Commission, *Communication from the Commission on Criteria for the Analysis of the Compatibility with the Internal Market of State Aid to Promote the Execution of Important Projects of Common European Interest* (Brussels: European Union, 2021), accessed via EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC1230(01)

[131] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.5 Brussels: European Union, 15 July 2022.

d) Spillovers are also extended through clusters, alliances, professional bodies, and a European network of research and technology organisations.[132]

Governance of spillovers: To make these commitments enforceable, spillovers are embedded in Hy2Tech's governance.

a) The Supervisory Board monitors dissemination activities.
b) The General Assembly designates a dedicated spillover contact.
c) The Facilitation Group maintains a public website and calendar where events and results are posted.

Reporting obligations at project and national level mirror these duties, creating a legal basis for enforcement and ensuring that proportionality safeguards are respected. In its compatibility assessment, the Commission stresses that these instruments translate the legal requirement of positive spillovers into an auditable routine.[133]

Feedback function: Spillovers are not conceived as one-way diffusion, but as part of a feedback loop. Demonstration projects in TF4 generate operational data and interface experience that are shared upstream with TF1, TF2, and TF3, accelerating refinement of materials, designs, and production processes. The Commission also notes spillovers beyond hydrogen itself, with applications expected in renewable fuels, heating, and storage markets. In this way, collaborations and spillovers become the mechanism through which Hy2Tech evolves as an integrated industrial programme over time, rather than a static set of projects.[134]

5.4 Financing and aid architecture

5.4.1 Aid measures: in-scope and out-of-scope activities

The financial design of Hy2Tech reflects a deliberate choice: to intervene where private capital is least willing to bear risk. These are the stages of precompetitive research and the first-of-a-kind industrialisation that transform laboratory results into replicable production platforms. By contrast, mass roll-out phases—where risks are lower and markets can step in—remain outside the programme.

[132] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.5.1, 2.5.2, 2.5.3 Brussels: European Union, 15 July 2022.

[133] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.5 Brussels: European Union, 15 July 2022.

[134] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.5.4 Brussels: European Union, 15 July 2022.

Forms of aid: To address these early, high-risk stages, the Commission authorised Member States to deploy mainly direct grants, complemented where appropriate by repayable advances and other national instruments that remain compatible with EU State aid rules. In every case, disbursements are strictly conditional: they are tied to verifiable milestones and to the funding-gap analysis submitted by the beneficiary.

Eligible scope: The perimeter of eligible activities is drawn tightly around the innovation-to-industrialisation bridge:

a) R&D&I covers materials and component innovation, validation in relevant environments, and standardisation work.
b) FID includes pilot and pre-series lines, automation concepts, end-of-line testing, and system packages that are ready for integration.

Excluded, however, are mass-deployment infrastructures such as generic hydrogen refuelling networks. These fall explicitly outside Hy2Tech's remit, so as not to crowd out other instruments and to preserve the programme's focus on first-mover industrialisation rather than routine roll-out[135]

Application across Technology Fields: The Decision applies this demarcation consistently to each TF:

1. In TF1, aid supports the re-engineering of electrolysers and the automation of manufacturing steps not yet available at scale.
2. In TF2, it covers advances in catalysts, membranes and bipolar plates, along with the industrialisation of stack and module production, including digital monitoring and quality control.
3. In TF3, it supports the industrialisation of composite high-pressure vessels with embedded health monitoring, as well as underground storage pilots.
4. In TF4, it covers first-series integration of heavy-duty powertrains and high-throughput refuelling elements, but only as part of testing and validation—not as generic deployment.

This boundary is central to the Commission's proportionality assessment. Hy2Tech funds precisely the stages where uncertainty, indivisibilities and risk deter private finance—thereby generating learning, standardisation and reference platforms. Subsequent diffusion is deliberately left to other instruments or to later hydrogen IPCEIs such as Hy2Infra or Hy2Move.[136]

[135] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.6 Brussels: European Union, 15 July 2022.

[136] European Commission. 2022. *C (2022) 5158 final, public version,* §§ 2.6.2 Brussels: European Union, 15 July 2022.

5.4.2 Selection of participating undertakings

The composition of Hy2Tech's portfolio—41 projects carried out by 35 direct participants—was not the product of closed negotiations, but of open national calls launched between 2019 and 2021. While procedures differed across Member States, the Decision highlights a common funnel: public calls for expressions of interest, short-listing against shared criteria, and structured dialogues with the Commission during pre-notification to align scope and evidence

National examples: The Decision illustrates this pattern with several representative cases:

a) In France, two national calls (January 2020 and May 2021) attracted roughly 80 project portfolios; 15 were pre-selected and 10 ultimately notified.
b) In Germany, a January 2021 call generated around 230 project sketches, reduced to 62 for European matchmaking, and four formal notifications.
c) In Italy, an expression-of-interest procedure launched in January 2019 gathered about 180 project sketches; 52 were pre-selected for matchmaking, leading to six notified projects.
d) In Spain, three calls (June and December 2020, May 2021) yielded more than 500 proposals, from which four projects were notified.

Selection criteria.: Across all countries, projects were assessed against a consistent set of requirements, later harmonised in the joint Chapeau:

a) demonstrable technological advance beyond the state of the art
b) credible collaboration plans within and across Technology Fields
c) spillover and dissemination commitments targeting SMEs and research organisations
d) financial robustness and capacity to co-invest, and
e) substantiated funding-gap models based on externally benchmarked assumptions.[137]

Specific features of Hy2Tech's selection process: Two aspects distinguish this IPCEI's selection process.

1) First, most undertakings were required to combine both R&D&I and FID activities within their projects. Only a handful were limited to one or the other, reflecting their starting technological position.
2) Second, the geographic distribution was deliberately calibrated to maximise complementarity

[137] European Commission. 2022. *C (2022) 5158 final, public version,* §2.6.1. Brussels: European Union, 15 July 2022

across Europe rather than replicate capacities. The Decision notes:

- electrochemistry and advanced manufacturing anchors in Germany and France
- electrolyser capacity aligned with Benelux port logistics
- Iberian integration models linking renewables to early offtake
- Nordic–Baltic expertise mitigating exposure to critical materials, and
- Central-Eastern pilots on subsurface storage.

5.4.3 Eligible costs, aid amounts, and funding timeline by Member State

The Decision records in detail the financial architecture of Hy2Tech at national level. For each notified measure, it specifies aid ceilings per undertaking and the schedule of disbursements. These are typically milestone-based tranches, linked to measurable technical or industrialisation steps.

Variation in aid amounts: Because ceilings are calculated on the basis of counterfactual cash-flow models submitted by each beneficiary, the amounts differ considerably across projects. Variations reflect both the Technology Field and the maturity and capital intensity of the activity:

a) Higher-cost items include electrolyser and fuel-cell manufacturing lines, the industrialisation of composite vessels, and subsurface storage pilots.
b) Lower-cost items include system integration and validation packages in TF4. Even if less capital intensive, these are strategically important because they serve as exposure mechanisms that render upstream innovations bankable.

Confidentiality: Not all financial data are published. Some project-level figures are withheld as confidential business information. Where this is the case, the Decision nevertheless sets out the logic applied: the funding-gap method, the eligible-cost categories, rules on anti-cumulation, and the presence of claw-back triggers. National authorities are required to publish details at the time aid is granted, ensuring transparency within the compatibility framework. In practice, this means that while the aggregate aid envelope and the ceilings per undertaking are clear, the precise timing of disbursements is monitored through national funding agreements. These agreements are then consolidated into the programme's annual reporting cycle, which flows up to the Supervisory Board and the Commission.[138]

[138] European Commission. 2022. *C (2022) 5158 final, public version,* §2.6 and §2.9. Brussels: European Union, 15 July 2022

5.4.4 Safeguards: transparency, anti-cumulation, separate accounts, funding-gap, clawbacks

As previously mentioned in Chapter 4, compatibility under Article 107(3)(b) depends on proportionality: public support must be limited to the minimum necessary to trigger investment. Hy2Tech translates this principle into a set of operational safeguards that balance mission-oriented support with the discipline of competition law.

Funding-gap methodology: Each beneficiary is required to submit cash-flow models comparing the project with and without aid. Assumptions are benchmarked against external parameters such as cost of capital and market conditions. On this basis, the Commission calibrates the aid amount to the verified funding gap, not to the total eligible cost. The mechanism is stabilised *ex post* by clawback clauses: if realised profitability exceeds the projections notified, national authorities recover part of the aid above thresholds defined in the Decision and in funding agreements. [139]

Analytical accounts and anti-cumulation: To preserve competitive neutrality, beneficiaries must keep separate analytical accounts for aided projects, so that costs, revenues and profits can be isolated and audited. Anti-cumulation rules prevent undertakings from receiving overlapping support for the same costs from EU or national schemes. Where cumulation is possible—because the support covers distinct items or stages—it must be declared and monitored to avoid over-compensation.

Transparency obligations: Hy2Tech also embeds transparency into its design. Member States are required to publish aid awards in the State Aid Register, including the beneficiary's identity, the aid amount, and the project objective, within the Commission's deadlines. This creates a public record that can be scrutinised by competitors and stakeholders.[140]

5.5 Compatibility and expected outcomes

5.5.1 Compatibility assessment under the IPCEI framework

Hy2Tech was authorised as compatible with the internal market under Article 107(3)(b) TFEU following a granular, two-stage assessment that mirrors the architecture of the 2021 IPCEI

[139] European Commission. 2022. C (2022) 5158 final, public version, §§3.2–3.3 and §§2.7–2.9. Brussels: European Union, 15 July 2022

[140] European Commission. 2022. C (2022) 5158 final, public version, §§2.7–2.9. Brussels: European Union, 15 July 2022

Communication.

Eligibility: The first step was to verify that Hy2Tech met the eligibility requirements: that it constitutes a "project," that it pursues a "common European interest," and that it is "important" within the meaning of the framework. The Commission concluded that Hy2Tech qualifies as an integrated project, i.e. a group of single projects inserted in a common structure, roadmap, or programme aimed at the same objective and based on a coherent systemic approach. This characterisation anchors the programme's shared Chapeau, its four Technology Fields, and the governance framework that binds national measures into a single European undertaking. The Decision explicitly situates this legal finding within the IPCEI Communication and uses it to organise the subsequent compatibility test.[141]

Market failures and incentive effect: Having cleared eligibility, the Commission applied the balancing test required by the IPCEI framework. It first identified market and systemic failures: high-risk, capital-intensive hydrogen technologies such as electrolysers, fuel cells, storage logistics and heavy-duty end-uses face financing gaps and coordination failures that deter purely private provision—especially at first-of-a-kind scale and under conditions of supply-chain and critical-material risks. The Commission then verified the incentive effect: aid induces the projects by allowing undertakings to pursue activities that go significantly beyond the state of the art. The Decision documents expected advances, such as:

- substitution of scarce PGMs and fluorinated polymers
- more durable and efficient stacks
- automated manufacturing lines
- embedded sensing and structural health monitoring
- underground storage pilots, and
- heavy-duty powertrains and refuelling elements.[142]

Distortions and safeguards: To limit distortions, the Commission assessed risks of foreclosure, dominance and overcapacity. It concluded that, given the early stage of the hydrogen economy and the programme's diffusion and demonstration obligations, benefits outweigh risks. The Decision also records compliance with transparency, environmental safeguards under the DNSH principle, and anti-

[141] European Commission. 2022. C (2022) 5158 final, public version, §3.1, §3.2, §3.3.2 Brussels: European Union, 15 July 2022

[142] European Commission. 2022. C (2022) 5158 final, public version, §3.3.3 Brussels: European Union, 15 July 2022

cumulation vis-à-vis other EU or national funding.

5.5.2 Expected outcomes: investment, employment, skills and decarbonisation

The Commission frames Hy2Tech as more than a symbolic flagship. It is expected to generate measurable and verifiable outcomes that contribute directly to EU priorities on decarbonisation, industrial competitiveness, and technological sovereignty.

Investment and employment: At the macro level, the programme is projected to mobilise up to €13.5 billion in private R&D&I investment, backed by €5.4 billion in approved State aid. This scale of mobilisation is tied to substantial employment effects: around 20,000 direct jobs across engineering, advanced manufacturing, testing, validation, and operations. The jobs are geographically distributed across 15 Member States, reflecting the consortium's broad footprint. They are complemented by spillovers in training and skills: over 2,000 young researchers and technical staff are expected to benefit through collaborations with universities and RTOs, sponsored doctoral and master's positions, research chairs, and access to laboratory facilities under defined conditions. Knowledge diffusion is formalised through mandatory dissemination commitments, including more than 5,000 projected publications, presentations, and events, together with structured access regimes for SMEs and indirect partners.[143]

Technological outcomes: Hy2Tech's ambition is not to roll out infrastructure, but to de-risk and industrialise the key components of the hydrogen value chain. Its expected results are framed around collapsing costs, improving durability and efficiency, and validating technologies in operational environments so that later waves (Hy2Use, Hy2Infra, Hy2Move) can deploy proven, interoperable solutions at scale. The Decision sets quantitative targets, including:

a) scaling electrolyser production capacity to more than 10 GW per year by 2030
b) raising solid oxide fuel-cell efficiency to around 60%
c) extending PEM fuel-cell lifetimes to 30,000 hours in mobility applications, and
d) expanding underground hydrogen storage from 0.9 TWh per year in 2031 to 4.3 TWh beyond 2050.

In practical terms, these ambitions translate into deliverables such as recyclable, lower-footprint materials for electrolysers and fuel cells, durable and efficient stack designs, scalable production processes, digitally monitored storage systems, and validated heavy-duty powertrains for road, rail

[143] European Commission. 2022. C (2022) 5158 final, public version, §3.3.2.2 Brussels: European Union, 15 July 2022

and maritime applications. The emphasis throughout is on manufacturability and interoperability: the aim is to deliver industrially viable solutions for European OEMs, not isolated prototypes.

Systemic effects: Beyond costs and decarbonisation, Hy2Tech explicitly tackles systemic barriers that have hindered hydrogen deployment. By aligning 41 direct participants and more than 300 indirect partners across the value chain, it addresses coordination failures that would otherwise delay investment in generation, storage, distribution, and end-use. It also reduces information asymmetries: Member State co-financing and Commission oversight provide investors with transparency and regulatory certainty, lowering perceived risk. Positive externalities are embedded by design, through obligations on FRAND licensing of results, structured training programmes, open access to pilot lines, and annual dissemination events via a dedicated Hy2Tech platform.[144]

Taken together, these outcomes anchor Hy2Tech's objectives in verifiable commitments. The Decision codifies technical milestones, collaboration duties, and reporting requirements so that investment, employment, and decarbonisation are not aspirations but operationalised results. While risks remain—such as delays in disbursement or broader macroeconomic headwinds—the governance framework of clawbacks, KPIs, and dissemination duties ensures close supervision. In this way, Hy2Tech exemplifies how State aid can be tied not only to hydrogen research but to a structured process of industrial transformation, integrated into Europe's climate, energy, and industrial strategies.

Table 5.2 — *Expected outcomes of Hy2Tech*

Category	Expected results
Investment	€13.5bn private mobilised; €5.4bn State aid approved
Employment	20,000 direct jobs; 2,000+ young researchers/technical staff trained
Technological targets	10 GW electrolyser capacity by 2030; SOFC efficiency ~60%; PEM lifetime 30,000h; storage 0.9 → 4.3 TWh
Knowledge diffusion	5,000+ publications/events; structured SME access
Systemic effects	FRAND licensing; open access to pilot lines; annual dissemination events

Source: European Commission. Important Project of Common European Interest on Hydrogen Technology (Hy2Tech), Commission Decision C (2022) 5158 final. Brussels, July 15, 2022

[144] European Commission. 2022. C (2022) 5158 final, public version, §3.3.2.2 Brussels: European Union, 15 July 2022

Chapter 6 — Italy and Hy2Tech

6.1 Italy's IPCEI Framework

6.1.1 Establishment and working of the National IPCEI Fund

Turning to Italy's participation in Hy2Tech, it must be noted that the Italian legal order foresees a dedicated financial and administrative structure purpose-built to support IPCEIs.

Financial framework: Under the financial perspective, the cornerstone of this structure is the "IPCEI Fund" (the so-called "Fondo IPCEI"), established by Law No. 145 of 30 December 2018, which earmarked resources initially intended for the microelectronics IPCEI.[145] Since that date, the Fund has been the object of different refinancing:

1. Law No. 160 of 27 December 2019 opened its scope to all strategic European value chains and added EUR 10 million for 2020 and EUR 90 million for 2021.[146]
2. Decree-Law No. 104 of 14 August 2020, Article 60(6) allocated an additional EUR 950 million for 2021, thereby reinforcing its financial capacity[147].

While the Fund is established within the Ministry's budget under a dedicated accounting line, Regions and other public administrations may contribute additional resources, and up to 0.35% of the total allocation can be used to cover administrative costs. The Fund may also be combined with European programmes, provided the respective rules are respected.

Governance: As to the operational framework of the Fund, it was entrusted to the Ministry of Economic Development (MISE), later renamed the Ministry of Enterprises and Made in Italy (MIMIT). As a result, Italy has a multi-annual, anchored vehicle for participation in IPCEIs, replacing ad hoc appropriations with a permanent instrument capable of co-financing complex projects.
Regulatory consolidation: The operational framework of the Italian IPCEI Fund was consolidated by

[145] From a financial standpoint, the cornerstone of the Italian participation is the National IPCEI Fund (*Fondo IPCEI*), established by Law No. 145 of 30 December 2018. This instrument, originally created to support the microelectronics IPCEI, earmarked progressively increasing resources for European projects of common interest: EUR 50 million per year in 2019–2020, EUR 60 million in 2021, and EUR 83.4 million per year from 2022 to 2024.

[146] *Gazzetta Ufficiale*, *Legge 27 dicembre 2019, n. 160. Bilancio di previsione dello Stato per l'anno finanziario 2020 e bilancio pluriennale per il triennio 2020–2022* (Rome: Gazzetta Ufficiale, 2019), https://www.gazzettaufficiale.it/eli/id/2019/12/30/19G00165/sg.

[147] *Gazzetta Ufficiale*, *Legge 30 dicembre 2020, n. 178. Bilancio di previsione dello Stato per l'anno finanziario 2021 e bilancio pluriennale per il triennio 2021–2023* (Rome: Gazzetta Ufficiale, 2020), https://www.gazzettaufficiale.it/eli/id/2020/12/30/20G00202/sg.

the Interministerial Decree of 21 April 2021, which translated into national law the requirements set out in the Commission's IPCEI Communication and in subsequent authorisation decisions. Unlike an *ex post* adjustment, the decree was conceived as an *ex ante* compliance by design instrument: its purpose was to align Italian procedures with European criteria from the outset, reducing the risk of misalignment and shortening approval times.[148]

Three sets of innovations were decisive:

1. The decree introduced a series of definitions harmonised with EU terminology. These included: a) the register of experts in technological innovation, used by the Ministry for *ex ante, interim*, and *ex post* evaluations, b) the notion of strategic value chains as identified by the Commission, c) the funding-gap principle as the benchmark for determining aid intensity and d) the category of First Industrial Deployment (FID) as distinct from R&D&I.
2. Another important innovation was the clarification of the portfolio structure. National projects were no longer treated as autonomous initiatives, but as segments of a broader European programme, integrated through the common Chapeau and its technical annexes. This ensured that national financing was functionally tied to the collective objectives of the IPCEI, reinforcing the cross-border rationale that distinguishes it from ordinary State aid schemes.
3. Finally, the decree strengthened the administrative routines that support the Fund. Application procedures, reporting duties, and documentation requirements were standardised, making data more comparable and easier to integrate into the European monitoring system. While technical in appearance, these routines are essential: they ensure that the Fund works not only as a financing source, but also as a reliable interface between national authorities, European institutions, and industrial participants.

6.1.2 Eligibility: subjective and objectives

The Italian decree defines eligibility along two dimensions: who can participate and what activities and costs can be supported.

Subjective eligibility: Access to the Fund is limited to undertakings expressly authorised by a Commission decision and formally admitted by the Italian authorities. Beneficiaries must be

[148] Ministero dello Sviluppo Economico, *Decreto interministeriale 21 aprile 2021. Fondo IPCEI: criteri generali per l'intervento e il funzionamento del Fondo* (Rome: MISE, 2021), https://www.mimit.gov.it/it/normativa/decreti-interministeriali/decreto-interministeriale-21-aprile-2021-fondo-ipcei-criteri-generali-per-l-intervento-e-il-funzionamento-del-fondo.

incorporated in Italy, financially sound, and free of outstanding recovery obligations. Firms in difficulty are excluded, unless their distress arose after 31 December 2019 as a result of external shocks. Research organisations are also eligible, provided they keep separate accounts for economic activities. Exclusion applies in cases of criminal convictions of company managers or the imposition of corporate sanctions.[149]

Objective eligibility: Supported activities include both R&D&I and FID, provided they are highly innovative and demonstrably go beyond the state of the art. Dissemination of results is also explicitly recognised as an admissible activity. Eligible costs follow the categories set out in the IPCEI Communication:

- feasibility studies
- depreciation of instruments and equipment
- proportional costs for land, buildings, and infrastructure
- materials and supplies
- acquisition and defence of intellectual property rights
- contractual research, consultancy, and personnel costs
- administrative expenses directly linked to R&D&I or FID, and
- in the case of FID, capital and operating costs, insofar as they are intrinsic to the innovative purpose of the project and not equivalent to mass production.[150]

Timing, intensity and cumulation safeguards: The decree also imports, from the Commission Communication, strict rules on the timing, intensity and cumulation of aid. Support may be granted only after Commission authorisation and within the approved limits. Aid intensity, calculated under the funding-gap methodology, may reach up to 100% of eligible costs but cannot exceed the authorised gap, with mandatory co-financing. Research organisations not designated as direct recipients may still obtain support within the ceilings set for their projects. Anti-cumulation rules prevent the same expenditure from being financed by multiple schemes; cumulation is allowed only for distinct cost categories or complementary activities within the authorised limits.[151]

[149] Ibid.

[150] Ibid.

[151] Ibid.

6.1.3 Procedural aspects

The procedures for implementing the IPCEI Fund are designed to combine transparency, predictability and administrative rigour. They provide a structured pathway from the initial call for proposals to the final disbursement of aid, while ensuring continuous oversight at both national and European levels

Procedural framework: Implementation begins with calls for expressions of interest published by the Ministry, which define the industrial scope, identify the relevant strategic value chains, and set the conditions of participation. Proposals are subjected to a national pre-assessment to verify compliance with IPCEI criteria while also checking the availability of funds. Only projects passing this stage may be notified to the Commission for authorisation. Once authorisation is granted, an Activation Decree specifies the financial allocation and disbursement rules, which may include advances and milestone-based tranches. Aid is provisionally granted by a Director-General Decree, but remains conditional on anti-mafia checks and registration in the National State Aid Register.

Monitoring framework: Beneficiaries must maintain analytical accounts isolating project-related costs, submit regular progress and financial reports, and accept audits by both national and European authorities. Monitoring goes beyond financial compliance to include technical progress, dissemination of results, and adherence to environmental principles such as the DNSH criterion. Oversight also relies on external experts for technical evaluations, on-site inspections, and the possibility of consulting European governance bodies whenever interpretation of shared rules requires clarification.

Sanctions: In case of misrepresentation, failure to complete the project, unjustified non-achievement of objectives, insolvency or irregularities, aid may be revoked partially or entirely. A specific delocalisation clause applies: beneficiaries lose entitlement to support if subsidised activities are relocated outside the European Union (except within the EEA) within five years of completion. This safeguard ensures that taxpayer-funded innovation remains anchored in Europe.[152]

6.1.4 Further interventions

The regulatory framework of the Italian IPCEI Fund has been further refined through two subsequent ministerial circulars, which translated the principles of the 2021 decree into more detailed

[152] Ibid.

administrative practice.

The 2023 Circular: The first, MIMIT Circular No. 418933 of 12 December 2023, operationalised the compliance logic of the 2021 decree. Its main innovation was to lock project execution to the perimeter authorised by the Commission, prohibiting the reshaping of cost structures or objectives once aid had been approved. Adjustments were allowed only within narrowly defined limits, subject to justification and verification. The Circular also clarified cost-eligibility rules and introduced uniform reporting and traceability obligations, including the requirement that every transaction be electronically verifiable and linked to the authorised project portfolio.[153]

The 2024 Circular: The second, MIMIT Circular Prot. No. 140 of 22 January 2024, dealt with the impact of extraordinary corporate transactions—such as mergers, de-mergers, or transfers of business units—on project ownership. Its aim was to guarantee continuity: projects could change hands, but only if the successor entity met all eligibility requirements and the project's perimeter, objectives, and funding parameters remained unchanged. Where these conditions were satisfied, succession could be authorised without requiring a new Commission decision.[154]

6.2 Italy's participation in Hy2Tech

6.2.1 The Hy2Tech activation decree

The Italian Government translated the Commission's authorisation for Hy2Tech into national law through a dedicated activation decree, issued in October 2022 and consolidated in 2023. This measure gave Italy's participation a legally coherent, budgeted, and time-bound framework, transforming the European decision into an operational national programme.

Perimeter of participation: The decree explicitly confirmed the perimeter of Italy's participation by covering the Chapeau, the common technical annexes, and the individual project portfolios authorised at EU level. It designated the Directorate-General for Enterprise Incentives (DGIAI) as the implementing authority and opened a dedicated application window (28 November

[153] Ministero delle Imprese e del Made in Italy, *Circolare 12 dicembre 2023, n. 418933 – Fondo IPCEI: elementi e disposizioni per l'attuazione degli interventi* (Rome: MIMIT, 2023), https://www.mimit.gov.it/images/stories/normativa/circolare_12_dicembre_2023_n._418933_.pdf.

[154] Ministero delle Imprese e del Made in Italy, *Circolare 22 gennaio 2024, prot. n. 140 – Fondo IPCEI: disposizioni inerenti alla disciplina dei progetti – variazioni soggettive* (Rome: MIMIT, 2024), https://www.mimit.gov.it/images/stories/IncentiviImprese_Normativa/Fondo_IPCEI_-_Circolare_variazioni_soggettive_2.pdf.

2022 – 30 January 2023), restricted to undertakings named in the Commission's authorisation decision. Research organisations identified during the national pre-assessment could also participate, provided they operated outside the State aid regime. This preserved the integrated European logic while creating a single national entry point for Italian beneficiaries. [155]

Financial allocation: The decree earmarked €700 million for Hy2Tech, €450 million under Mission 4, Component 2, Investment 2.1 (IPCEIs), and €250 million under Mission 2, Component 2, Investment 5.2 (Hydrogen). This allocation could be supplemented by regional or other public co-financing, provided it stayed within the ceilings authorised by the Commission. Execution was bound to the funding-gap principle: aid covered only the difference between discounted project costs and expected revenues, and could never exceed the validated financing need. If resources proved insufficient, funding had to be distributed proportionally in line with Commission ceilings.[156]

Traceability and accountability: The decree placed strong emphasis on traceability. Beneficiaries had to maintain separate analytical accounts for aided activities, apply a Codice Unico di Progetto (CUP) to all documentation, and ensure every disbursement was linked to a corresponding invoice or equivalent probative record. Expenditures for R&D&I and FID had to be recorded separately, and any revenues generated by the project had to be attributable to the subsidised activities.[157]

Disbursement rules: Payments were conditional on verified progress. DGIAI performed both formal and substantive checks, after which successful applicants received individual concession decrees mirroring the authorised portfolio. Disbursements were tied to technical and administrative milestones, documented with evidence and expert assessments.

- Advances were possible: generally capped at 10% of the grant, but exceptionally up to 40% if justified and backed by a guarantee, mitigating cash-flow constraints in capital-intensive projects without undermining proportionality.

[155] Ministero delle Imprese e del Made in Italy, *Decreto di attivazione IPCEI H2 Tech – versione consolidata*, art. 1 (Rome: MIMIT, 2022/2023), https://www.mimit.gov.it/images/stories/normativa/DECRETO_di_attivazione_IPCEI_H2_Tech_-_consolidato_.pdf

[156] Ministero delle Imprese e del Made in Italy, *Decreto di attivazione IPCEI H2 Tech – versione consolidata*, arts. 5(3)–(4) (Rome: MIMIT, 2022/2023), https://www.mimit.gov.it/images/stories/normativa/DECRETO_di_attivazione_IPCEI_H2_Tech_-_consolidato_.pdf.

[157] Ministero delle Imprese e del Made in Italy, *Decreto di attivazione IPCEI H2 Tech – versione consolidata*, arts. 3(7)–(8) (Rome: MIMIT, 2022/2023), https://www.mimit.gov.it/images/stories/normativa/DECRETO_di_attivazione_IPCEI_H2_Tech_-_consolidato_.pdf.

- Change control was deliberately strict: variations could not alter the EU-authorised scope, objectives, or implementation logic, and any adjustments had to respect the limits of the decree and the deadlines of the NRRP funding source.[158]

Monitoring regime: A comprehensive monitoring framework was embedded. Beneficiaries had to submit periodic technical and financial reports, accept on-site inspections, and deliver a final report within three months of completion, including declarations on no double funding and compliance with the DNSH principle. To operationalise DNSH, the Ministry issued Circular No. 880 of 11 April 2025, which required verification not only *ex ante* at Commission level, but also at every payment stage and in the final report. Beneficiaries had to provide:

- self-declarations
- progress reports with DNSH sections, and
- final statement signed by the technical manager, supported where appropriate by certifications, lifecycle assessments or best available techniques (BAT).

6.2.2 The funding of Hy2Tech

The funding of Hy2Tech in Italy rests on a sequence of ministerial decrees that progressively translated the National IPCEI Fund into practice, linking resources from the NRRP to the Commission's authorisation decisions.

The June 2022 decree: The Ministerial Decree of 27 June 2022 activated the Fund with resources drawn from the Italian NRRP, not only for hydrogen IPCEIs (Hy2Tech and Hy2Industry), but also for other strategic value chains such as cloud infrastructures and microelectronics. It earmarked €1.5 billion under Mission 4, Component 2, Investment 2.1 (IPCEIs) and €250 million under Mission 2, Component 2, Investment 5.2 (Hydrogen), strictly tied to projects admitted under the relevant Commission authorisations. Additional allocations could follow through future decrees or from EU and national sources, all managed through special account no. 1726.[159]

Beneficiaries had to be expressly named in the Commission's decision, while research organisations admitted during national pre-selection could also participate outside the State aid regime. Calls for

[158] Ministero delle Imprese e del Made in Italy, *Decreto di attivazione IPCEI H2 Tech – versione consolidata*, art. 3(6) (Rome: MIMIT, 2022/2023), https://www.mimit.gov.it/images/stories/normativa/DECRETO_di_attivazione_IPCEI_H2_Tech_-_consolidato_.pdf.

[159] Ministero dello Sviluppo Economico, *Decreto di attivazione IPCEI 27 giugno 2022* (Rome: MISE, 2022), https://www.mimit.gov.it/images/stories/normativa/Decreto_IPCEI_27062022.pdf.

applications were required within 90 days of notification and had to include the approved project portfolio, technical sheets, antimafia documentation, and designation of a concession signatory. DGIAI then verified admissibility, registered the aid in the National State Aid Register, and issued concession decrees specifying eligible costs, the CUP, and beneficiaries' obligations.[160]

The October 2022 decree: The Ministerial Decree of 21 October 2022 (consolidated in 2023) gave concrete financial effect to the June framework. It channelled €450 million under *Mission 4, Component 2, Investment 2.1* and €250 million under *Mission 2, Component 2, Investment 5.2* specifically to support Hy2Tech. By anchoring these allocations to the Commission's July 2022 decision, the decree provided legal certainty for beneficiaries and bridged the 2021 governance framework with the operational financing of Italy's hydrogen IPCEI portfolio.[161]

The December 2023 decree: The Ministerial Decree of 11 December 2023 consolidated the financing trajectory by integrating resources across several strategic value chains. Unlike earlier decrees targeted at single fields, this act was conceived as a cross-cutting reinforcement of the National IPCEI Fund, making available over €1.7 billion to support hydrogen (Hy2Tech and Hy2Industry), microelectronics, batteries, and digital infrastructure. For hydrogen specifically, the decree addressed the residual financing gap left by earlier measures, ensuring that allocations could be topped up and stabilised. While it did not assign a stand-alone envelope to Hy2Tech, it clustered hydrogen together with other IPCEIs, allowing the Ministry to redistribute resources in line with authorised project portfolios and implementation needs

The May 2024 decree: This trajectory culminated in the Directorate Decree of 8 May 2024, which formally allocated resources across initiatives. For Hy2Tech, it added €455,719,773.51 to the amounts already activated under the October 2022 decree. This top-up was designed to close the residual funding gap of the authorised project portfolios and to stabilise Italy's co-financing profile in line with the Commission's decision. The act did not change Hy2Tech's scope or eligibility; it simply ensured that implementation could proceed with predictable cash flows and within EU-approved limits.[162]

[160] Ibid.

[161] Ministero delle Imprese e del Made in Italy, *Decreto di attivazione IPCEI H2 Tech – versione consolidata*, (Rome: MIMIT, 2022/2023), https://www.mimit.gov.it/images/stories/normativa/DECRETO_di_attivazione_IPCEI_H2_Tech_-_consolidato_.pdf

[162] Ministero delle Imprese e del Made in Italy, *Decreto direttoriale 8 maggio 2024 – Fondo IPCEI: integrazione delle*

6.3 The NRRP and hydrogen

6.3.1 The NRRP in Italy

Italy's National Recovery and Resilience Plan (NRRP) is embedded in the EU's Recovery and Resilience Facility (RRF), the central pillar of NextGenerationEU created to counter the economic shock of the pandemic. The RRF ties EU disbursements to the semi-annual achievement of milestones and targets up to 30 June 2026, ensuring that funding is conditional on reforms and investments. [163]

Objectives and structure: The Italian NRRP reflects both EU thematic requirements and national priorities. The original plan was organised into six Missions and sixteen Components, with binding climate and digital shares and a strong focus on territorial rebalancing. Following the December 2023 overhaul, Italy:

- introduced a new Mission 7 to incorporate the REPowerEU chapter
- raised the climate share to about 39 percent of the total envelope
- defined a portfolio of 66 reforms and 150 investments, corresponding to 618 milestones and targets to be delivered between the second half of 2021 and June 2026.

The revision also re-sequenced implementation, shifting a significant share of deliverables into 2025–2026 while maintaining the overall financial envelope at €194.4 billion: €122.6 billion in loans and €71.8 billion in grants. At least 40 percent of territorially allocable resources remain earmarked for the Mezzogiorno. [164]

Governance: Governance of the NRRP has been progressively codified in primary legislation. The Decreto-Legge 77/2021 established the Cabina di regia at Cabinet level, chaired by the Prime Minister, with responsibility for strategy, sequencing, troubleshooting, and parliamentary reporting. Regional and local authorities participate when territorial issues are concerned. Later reforms (DL 13/2023 and DL 19/2024) further strengthened this architecture by creating a Struttura di Missione within the Presidency of the Council of Ministers, ensuring day-to-day coordination with the European Commission.[165]

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risorse (Rome: MIMIT, 2024), *Gazzetta Ufficiale* n. 115, 18 May 2024, https://www.mimit.gov.it/it/normativa/decreti-direttoriali/decreto-direttoriale-8-maggio-2024-fondo-ipcei-integrazione-delle-risorse.

[163] Camera dei deputati, *"Il NRRP italiano. Un quadro di sintesi"*, Temi della Camera, https://temi.camera.it/leg19/NRRP/NRRPItalia/OCD57-2/il-NRRP-italiano-quadro-sintesi.html.

[164] Ibid.

[165] Camera dei deputati, *"La governance del NRRP"*, Temi della Camera, https://temi.camera.it/leg19/NRRP/NRRPItalia/OCD57-3/la-governance-del-NRRP.html.

Administrative management: At the administrative level, responsibility lies with the Ministry of Economy and Finance (MEF), through the Ragioneria Generale dello Stato (RGS) and its dedicated inspectorate (IG-PNRR). These bodies handle operational coordination, financial management, monitoring, and reporting. The digital backbone is the legally mandated ReGiS platform, used for programming, monitoring, control, and audit. With DL 19/2024, obligations on data entry and monthly updates were tightened, and corrective measures were introduced in case of delays or deficiencies. [166]

Resource allocation: Resources are distributed on a semi-annual rhythm. The first MEF decree (August 2021) assigned funds across ministries, linking them to milestones and targets; subsequent decrees updated these tables. Line ministries act as "amministrazioni centrali titolari," while "soggetti attuatori" — public or private entities — are responsible for execution, verifying expenditure eligibility, and ensuring compliance with EU rules.[167]

Oversight and accountability: Oversight is multi-layered. At EU level, the Commission validates disbursements against milestones and targets. Nationally, the Corte dei conti reports periodically to Parliament on efficiency and effectiveness. Although removed from in itinere control in 2023, the Court continues to conduct *ex post* reviews and to publish analyses of progress and risks. [168]

6.3.2 Hydrogen measures under the NRRP

In Italy's NRRP, hydrogen is conceived as a deployment pathway rather than a single project. The pathway begins with territorial production–use clusters, extends into refuelling networks and rail pilots, supports industrial substitution where electrification is not feasible, and is sustained by research, development and industrial-policy measures that localise the supply chain.

[166] Ibid.

[167] Camera dei deputati, *"L'attuazione del NRRP"*, Temi della Camera, https://temi.camera.it/leg19/NRRP/NRRPItalia/OCD57-4/l-attuazione-del-NRRP.html.

[168] Ibid.

Table 6.1 — *Hydrogen-related investments in Italy's NRRP*

Investment line	Objective / Focus
Mission 2, Component 2, Investment 3.1 — Hydrogen Valleys	Deployment of renewable-hydrogen production and use in brownfield sites. Electrolysers co-located with industrial and mobility users to reduce permitting times, logistics costs, and create bankable demand.
Mission 2, Component 2, Investment 3.2 — Hydrogen use in hard-to-abate industries	Pilot projects in steel, glass, ceramics, paper, and chemicals. Aim: demonstrate feasibility of hydrogen as process heat and feedstock at plant scale (burners, controls, safety, product quality). Competitive calls are managed by MASE.
Mission 2, Component 2, Investment 3.3 — Hydrogen testing for road transport	Deployment of at least 40 hydrogen refuelling stations. Priority: freight corridors (motorways, ports, logistics hubs), Brenner Green and Digital Corridor, and Turin–Trieste axis.
Mission 2, Component 2, Investment 3.4 — Hydrogen testing for railway mobility	Conversion of non-electrified railway lines (Valcamonica, Salento). Integration of hydrogen production, distribution, and trains. Targets ~10% of Italy's diesel-operated rail network.
Mission 2, Component 2, Investment 3.5 — Hydrogen Research and Development	Support for applied research and pre-commercial development: electrolysers, storage systems, carriers, fuel cells, and digital controls. Includes REPowerEU reinforcements. Cooperative projects between firms, universities, and RTOs.
Mission 2, Component 2, Investment 5.2 — Hydrogen	Creation of a domestic hydrogen industrial base. Financing of manufacturing plants for electrolysers and components, and supply-chain initiatives. Direct support to Italian participation in European IPCEIs.

Source: Presidency of the Council of Ministers — Struttura di Missione PNRR, Sesta relazione al Parlamento sullo stato di attuazione del PNRR (2024)

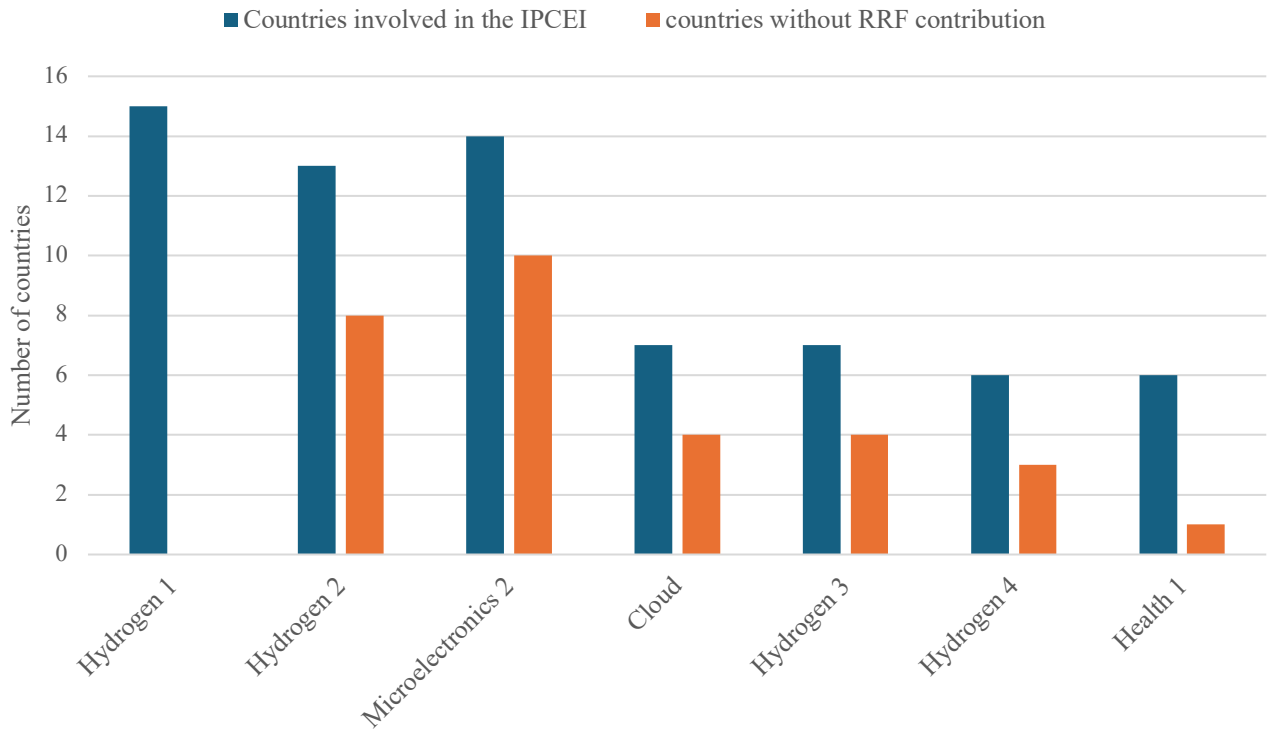
Taken together, these measures portray hydrogen in the NRRP as a nationally anchored pathway of deployment and industrial policy. Yet, this pathway does not stand alone: it intersects with the European IPCEI framework, where Italy channels part of its NRRP resources into Hy2Tech, thereby linking domestic implementation to a broader cross-border strategy**.**

6.4 The NRRP and Hy2Tech

The launch of Hy2Tech coincided with the second wave of IPCEIs and with the operationalisation of the Next Generation EU programme. Through the RRF, Member States could, for the first time, complement national State aid with European resources, turning the NRRP into a co-financing vehicle for cross-border industrial alliances. In the case of hydrogen, this mechanism proved decisive: about €10.5 billion of RRF resources were mobilised across the Union for Hy2Tech and Hy2Use, corresponding to roughly half of the total authorised public support. This broadened participation to Member States with more limited fiscal capacity, particularly in Central and Eastern Europe, and

reinforced the pan-European character of the initiative. Notably, the decision to draw on RRF resources was not limited to Italy: as Figure 6.1 illustrates, most Member States involved in the hydrogen IPCEIs opted for European co-financing, whereas in other domains (microelectronics, cloud, health) reliance on the RRF remained more limited. [169]

Figure 6.1 - *Participation in IPCEIs and use of the RRF*



Source: European Commission, Approved IPCEIs, State Aid — Important Projects of Common European Interest (IPCEI), https://competition-policy.ec.europa.eu/state-aid/ipcei/approved-ipceis_en (Brussels: European Union, last accessed 25 September 2025).

6.4.1 Hy2Tech in the NRRP investment architecture

The financial architecture of the Italian NRRP towards Hy2Tech is anchored in two NRRP investment lines.

a) Mission 4, Component 2, Investment 2.1 (M4C2-I2.1, IPCEI), with a total allocation of €1.5 billion to support participation in European IPCEIs across strategic value chains, from microelectronics and batteries to hydrogen and cloud infrastructures. Within that envelope, €450 million is earmarked specifically for Hy2Tech.

b) Mission 2, Component 2, Investment 5.2 (M2C2-I5.2, Hydrogen), endowed with €450 million to develop a domestic hydrogen value chain, including the manufacturing of

[169] Fontana, Olimpia. Gli IPCEI come pilastro della nascente politica industriale europea. Policy Paper NS 006, Fondazione CSF, settembre 2025.

electrolysers, balance-of-plant, and related components. Of this amount, €250 million is committed to Hy2Tech projects.

Taken together, Hy2Tech in Italy therefore rests on a €700 million NRRP allocation within a much larger NRRP framework but reserved exclusively for the IPCEI on hydrogen technologies. This decision guarantees funding for Italian Hy2Tech beneficiaries and binds their implementation to the same auditability, climate tagging, digital tagging, and DNSH constraints that govern the broader Recovery Plan.

Institutional choice: Italy's approach differs from other Member States. Instead of mobilising separate national budgets, the government chose to finance the entire Hy2Tech portfolio directly through the NRRP. In practice, this means that each euro of public funding must satisfy two disciplines simultaneously: State aid compatibility under EU competition law, and RRF conditionality, tied to milestones and a fixed deadline of June 2026.

6.4.2 Dual compatibility and institutional governance

This dual anchoring responds to a structural risk. Hy2Tech is designed to push hydrogen technologies beyond the state of the art through research, development and first industrial deployment, while the NRRP aims to generate immediate demand, infrastructure, and institutional capacity within a limited timeframe. Keeping the two regimes separate would risk duplication, fragmented audit trails, and a "valley of death" where prototypes lacked deployment opportunities before the NRRP window closed.

Italy's participation in Hy2Tech is therefore grounded in a layered framework that combines legal safeguards with institutional coordination, ensuring compliance both with EU State aid rules and with the RRF regime. At its core stand the Hy2Tech activation decree (2022, consolidated in 2023) and the Ministerial Decree of 27 June 2022, which introduces the safeguards that make this dual compliance possible.

Three safeguards are decisive for different reasons:

a) Unique cost mapping: Every budget line must be financed by one and only one source, and analytical accounts must reflect this separation. The CUP (Codice Unico di Progetto) assigned at the start travels across all contracts, invoices, and payment orders, while procurement processes attach a CIG (Codice Identificativo Gara) code for traceability.

b) The funding-gap ceiling**:** Even if multiple public sources finance different items, the total public contribution cannot exceed the Commission-authorised funding gap defined in the Hy2Tech financial model.

c) Activities financed must remain strictly within the perimeter of the EU-approved project portfolio; any material changes require prior notification and, if significant, Commission re-approval. These are the provision which allow the same projects to be audited and validated both by State aid controllers and by RRF auditors.

The activation decree translates these safeguards into practice:

a) At application, firms must submit the Commission-approved portfolio, the authorised funding-gap model, and a standardised technical sheet that decomposes costs by category and activity, alongside declarations of conflicts of interest and anti-mafia certifications.
b) During implementation, payments are linked to progress reports and cost statements**,** and advances are capped *ex ante* and backed by sureties (bank or insurance guarantees for firms, budgetary set-asides for research bodies). Crucially, DNSH compliance must be demonstrated with the same evidentiary standards required for the NRRP, referencing the Commission's 2021 technical guidance. Monitoring data flows directly into ReGiS**,** the centralised database used for RRF tracking, ensuring that EU-level controllers—including the Commission services, OLAF, EPPO, and the European Court of Auditors—can cross-check Hy2Tech projects using the same ledgers as NRRP milestones.

Institutional responsibilities: This dual regime is mirrored at the institutional level. MIMIT is responsible for managing the IPCEI Fund and the Hy2Tech portfolio, including calls, eligibility checks, concession decrees and disbursements. MASE, by contrast, oversees NRRP Investment 5.2, dedicated to supporting the wider hydrogen value chain. Coordination between the two ministries has been progressively formalised: MIMIT consults MASE on activities falling under Investment 5.2, while both ministries rely on shared documentation standards, so that permits, environmental assessments, procurement registers and DNSH evidence are valid across both regimes.

Effects of alignment: This arrangement reduces duplication and transaction costs for firms, particularly SMEs and research organisations, which can operate under a single compliance framework rather than two fragmented regimes. It also strengthens administrative capacity by fostering inter-ministerial collaboration and ensuring that information collected for one financing line automatically contributes to oversight of the other. In practice, the result is a governance model where national institutions present a coherent interface both to the European Commission and to project participants, while guaranteeing that State aid and RRF conditionalities are applied consistently.

6.4.3 Milestones and outcomes

The implementation of Hy2Tech under the Italian NRRP is monitored through a set of milestones and targets established in the recovery plan. These markers are substantive rather than procedural: they specify concrete steps such as the launch of calls, the activation of funding mechanisms, the selection of beneficiaries, and the commissioning of industrial plants. Table 6.2 summarises the main milestones and targets under Mission 4, Component 2, Investment 2.1 and Mission 2, Component 2, Investment 5.2, indicating their content, mode of achievement, and current status.

Table 6.2 — *Milestones and targets under the NRRP*

Milestone/Target	Description	Result
M4C2-10	Publication of national calls for expressions of interest (hydrogen, microelectronics, cloud), in compliance with DNSH	Achieved in Feb–Mar 2021 via calls published on the Ministry's website, opening transparent and competitive project selection
M4C2-11	Entry into force of the national act assigning funds to IPCEI projects	Achieved on 27 June 2022 with ministerial decree activating the IPCEI Fund
M4C2-12	Finalisation of the list of projects admitted to the IPCEI portfolio	Achieved by 30 June 2023 with MIMIT completing beneficiary selection
M4C2-22	At least 20 projects supported via the IPCEI model by 2026	On track — Hy2Tech already represents a significant share
M2C2-52	Initiating industrial projects for electrolyser production	Achieved on 27 June 2022 with signing of projects "Turnkey electrochemical plants for H_2 production" (Ansaldo Green Tech) and "Gigafactory" (De Nora)
M2C2-53	Construction of at least one industrial electrolyser plant with 1 GW/year capacity by 2026	On track — modular planning ensures 1 operational plant by June 2026 within RRF timeframe

Source: Presidency of the Council of Ministers — Struttura di Missione PNRR, Sesta relazione al Parlamento sullo stato di attuazione del PNRR (2024)

6.4.4 Some remarks on the financing and coordination model defined

The analysis of Italy's financing and coordination model highlights several key implications, ranging from its immediate operational effects to its broader political and strategic significance.

*Accelerating learning and reducing risk***:** Ultimately, the Italian model is a strategy to accelerate learning and attract private capital. By exposing cost models to Commission scrutiny under Hy2Tech and then tying NRRP disbursements to milestones and DNSH proofs, the system generates unusually detailed operating data in early hydrogen deployments. Manufacturers can validate reliability curves,

operators can benchmark utilisation and safety, and financiers can observe audited case studies that reduce perceived risk in the next wave of projects.

Political and institutional significance: Beyond these operational dynamics, the model also carries a broader political meaning. The combination of State aid control with recovery governance illustrates how industrial policy instruments can be embedded within NRRP mechanisms without losing their European dimension. This approach goes beyond short-term financing needs: it sets a precedent for employing recovery funds as a structural lever of industrial strategy. In this perspective, the Italian case offers insights into how national and European objectives can converge, suggesting a model that could guide future cross-border projects and inspire other Member States.

From complementarity to identity: By choosing to finance Hy2Tech entirely from NRRP resources, Italy has turned complementarity into identity: a single compliance stack, a single traceability regime, and a shared calendar bridging technology push and market pull. This pathway — from laboratory to industrial line to operating landscape — remains visible and defensible both to State aid reviewers in Brussels and to RRF auditors in Luxembourg, while embedding hydrogen industrialisation firmly within the national recovery strategy.

Challenges and future directions: By relying exclusively on the NRRP, Italy narrowed the range of potential funding channels, foregoing the diversification that could come from other European instruments. In this perspective, the mid-term review of Cohesion Policy introduced a significant novelty by explicitly recognising the contribution of IPCEIs within the framework of cohesion funds. With the 2025 revision, the Commission proposed that resources from the ERDF and the Cohesion Fund could also be mobilised directly for projects participating in an approved IPCEI. This entails not only acknowledging the role of IPCEIs in fostering industrial innovation but also adapting cohesion policy itself by removing rigid ceilings on ERDF allocations, extending deadlines for reprogramming, and simplifying procedures to fast-track support for such projects. These developments highlight the growing convergence between cohesion policy and the IPCEI framework, opening the possibility for Member States — including Italy — to leverage structural funds more strategically in support of European flagship initiatives.[170]

[170] European Commission, *A Modernised Cohesion Policy: The Mid-term Review*, COM (2025) 163 final, Strasbourg, 1 April 2025.

In parallel, the Commission has also announced the creation of the European Competitiveness Fund within the framework of the Multiannual Financial Framework 2028–2034. This new instrument is designed to finance European public goods such as the clean transition, digital leadership, and industrial resilience, and it explicitly foresees support for public–private partnerships, including IPCEIs. Its integration with InvestEU and other financial partners will further expand the range of resources available for strategic industrial projects, potentially reinforcing the financing mix available to Member States and firms participating in IPCEIs.[171]

[171] European Commission, *A Dynamic EU Budget for the Priorities of the Future – The Multiannual Financial Framework 2028–2034*, COM(2025) 570 final, Brussels, 16 July 2025.

6.5 Institutional perspectives on Hy2Tech: Insights from MIMIT

The interview with officials from Division V — State Aid and European and International Industrial Cooperation — of the Directorate-General for Industrial Policy, Industrial Restructuring and Crisis, Innovation, SMEs and Made in Italy at MIMIT was conducted to complement official documentation with a direct perspective from the administration responsible for managing the IPCEI Hy2Tech in Italy. It was considered useful to gather this testimony in order to explore aspects not always evident in normative and institutional texts, such as the Ministry's role in coordinating with the European Commission and other Member States, the rationale behind financing choices, and the strengths and challenges observed during project implementation.

The Ministry provided valuable insights into the origins and implementation of the IPCEI Hy2Tech from an institutional perspective. Conceived between 2019 and 2020, Hy2Tech was the first major European integrated project on hydrogen, launched in a context where the market was not yet developed and costs remained non-competitive. Italy played an active role in preparatory technical discussions with the Commission and other Member States, contributing to the definition of technological priorities and focusing on advanced electrolysers, heavy-duty and maritime fuel cells, and innovative components, areas where concrete opportunities for European leadership were identified.

MIMIT acted as the lead administration, assuming not only responsibility for financial management but, above all, a complex institutional coordination role: it represented Italy vis-à-vis the Commission and other Member States, applied national selection criteria, ensured compliance with State aid rules, and coordinated companies and research institutions, with the scientific support of national bodies such as ENEA.

Policymakers noted that the decision to finance the Italian Hy2Tech projects through the Recovery and Resilience Facility was particularly significant. It enabled the mobilisation of additional resources aligned with EU priorities but also imposed strict milestones and targets, requiring intense negotiations with the Commission in order to reconcile the long-term nature of IPCEI projects with the shorter timelines of the RRF. At the same time, the Facility did not alter the initial decision of Member States to participate in Hy2Tech, since project portfolios and national commitments had already been defined before it came into force. Its contribution was therefore primarily quantitative — expanding the pool of resources — rather than strategic in shaping participation choices. Nevertheless, in the Italian case the mobilisation of RRF resources did not reduce the attractiveness of the instrument, as expressions of interest had already been collected and companies maintained strong expectations of financial coverage.

The Ministry also highlighted the importance of SMEs, which are structurally more vulnerable than large industrial groups. Less able to absorb delays and regulatory uncertainty, SMEs required constant support and clarification from the administration, confirming that one of the structural risks of the IPCEI model is the potential concentration of value chains around a few industrial champions.

In terms of governance, Hy2Tech followed the same architecture as other IPCEIs, with common decision-making and monitoring bodies, but at European level discussions are ongoing to enhance transparency and efficiency, underscoring the role of IPCEIs as governance laboratories.

The overall assessment provided by the Ministry brings to light both strengths and challenges. On the positive side, Italy ensured the qualified and diversified participation of companies and research centres, focused investments on strategic enabling technologies such as AEM electrolysers, maritime fuel cell solutions and innovative components, and generated significant economic and employment leverage, thereby strengthening the country's position in a strategic sector for the energy transition. On the critical side, rising costs due to inflation and energy and raw material prices, regulatory uncertainty linked to the launch of projects before the EU framework on RFNBOs was established, lengthy procedures, and the vulnerability of SMEs emerged as the main obstacles, disproportionately affecting smaller actors.

These findings show that the success of Hy2Tech will not depend solely on the volume of public resources mobilised but on the capacity to stabilise the operating environment, reduce regulatory uncertainty, and distribute risks more evenly across companies. In this sense, Hy2Tech represents both an opportunity for Italy to consolidate its technological leadership and a stress test for European industrial policy in building a hydrogen market that is still in the making. In this sense, the findings confirm the central claim advanced in the introduction: IPCEIs should be regarded not only as policy tools for competitiveness and decarbonisation, but as genuine institution-builders, capable of creating specialised administrations, embedding durable governance routines, and reinforcing long-term capacities across the Union.

Chapter 7 – Conclusions: IPCEIs as institution-builders

7.1 Summary of findings

The analysis carried out in this study has underlined the depth of the intertwining between EU and national administrations in the development of IPCEIs, a model of EU industrial policy which, since 2014, has been experiencing a rise in the operational activity of the Commission and its public discourse. As a matter of fact, the analysis of the general IPCEI framework, its application to hydrogen in the Hy2Tech project, and the specificities of the Italian case in relation to this project have allowed us to single out some elements:

a) The increasing role of the European Commission as a broker of private and public interests in specific strategic domains, carried out by using State aid discipline to foster inter-state public-private partnerships and the coordination of Member State activities in specific strategic sectors.
b) The importance of the Governance structure defined by the Commission for IPCEIs, in order to reach consensus and integration among different stakeholder of the Project and fostering a crucial exchange of information among the Member States and the industry, and strengthening links among different actors involved.
c) The crucial importance, in the national legal order, of having a dedicated internal financial and organisational framework for IPCEIs, with the effect of giving rise to specialised bodies able to develop long-term competencies and knowledge in specific strategic sectors and to foster cooperation with corresponding administrations in other Member States.
d) The relevance of National Recovery and Resilience Plans for the financing of IPCEIs in specific sectors where it would be difficult to raise private financing.

With specific reference to the Italian case, it must be underlined that it offers a valuable illustration of how the coexistence between the IPCEI framework and the NRRP can operate in practice.

In this respect, what can be considered a "double compliance regime" — in the sense it must simultaneously respect State aid rules and the milestone-based logic of the NRRP — has generated a unique administrative experiment with some clear effects:

- imposing a stricter culture of reporting and accountability and strengthening the technical capacity of national administrations, and
- introducing rigidity, as long-term innovation trajectories have had to adapt to the shorter deadlines of the RRF. At the same time, this constraint fostered durable administrative practices that may outlive the NRRP, embedding higher standards of compliance and coordination within the Italian administration.

Furthermore, the Italian experience suggests that IPCEIs can foster the creation of specialised public bodies and interministerial routines capable of accumulating administrative and technical knowledge over time. More specifically, it can be argued that this institutional learning process enhances the capacity of administrations to act not only as funders but also as strategic partners of industry, a dimension particularly relevant in high-risk technological sectors such as hydrogen.

Worth to mention, IPCEIs also show a territorial dimension. In Italy, advanced manufacturing activities are mostly concentrated in the North, while deployment pilots and demonstrators have been activated in the South. This dual geography suggests that, if well designed, IPCEIs can serve both technological upgrading and territorial rebalancing by involving Southern regions and smaller actors.

Beyond geography, challenges of inclusion also emerge at the firm level. SMEs, despite being widely recognised as key drivers of innovation, still face major obstacles. The procedures for application and reporting are often too technical and burdensome, forcing smaller firms to rely on costly external support. Slow approval processes also require SMEs to advance significant financial resources on their own, discouraging participation. This explains why, although their presence has grown over time—from just 7% in the first Microelectronics IPCEI to 64% in the most recent Health IPCEI—SMEs still account for only around 20% of total participants on average. Without simplification, clearer guidance and targeted assistance, the risk is that value chains remain dominated by a handful of large industrial champions.

Furthermore, asymmetries are also visible across Member States. Germany, France, and Italy together absorb about 70% of all State aid authorised under IPCEIs, while some Member States have never taken part in any project. Such disparities reflect unequal fiscal capacity and administrative resources, which risk reinforcing existing territorial divides within the Union

It can therefore be concluded that IPCEIs are a crucial instrument not only for their primary purpose—concentrating financial and technical resources on EU strategic objectives—but also for their side effects. By requiring constant interaction among administrations, firms, and research actors, they foster the development of administrative skills, long-term capacities, and governance routines that go beyond individual projects. The Italian experience in the hydrogen sector illustrates this clearly: it has strengthened administrative competence, created specialised routines, and fostered connections with other national administrations, all of which are essential for an effective EU industrial policy. This dual geography shows how IPCEIs can simultaneously support technological upgrading in advanced regions and contribute to territorial rebalancing through pilot projects in less industrialised areas. Yet, challenges of inclusiveness persist: SMEs remain underrepresented, and at the European level participation is still dominated by a few fiscally stronger Member States. This highlights the

need to ensure that IPCEIs serve not only competitiveness, but also cohesion and inclusiveness across regions and firms within the Union. In this sense, the findings confirm the perspective advanced in the introduction: IPCEIs should ultimately be regarded not only as funding instruments for strategic industrial projects, but also as institution-builders, fostering specialised administrations, durable governance routines, and long-term capacities that anchor European industrial policy.

7.2 Future challenges of the IPCEI model

The analysis has also made it possible to ascertain some of the aspects of IPCEIs that could be important in perspective. More specifically, the analysis of the concrete functioning of the Hy2Tech project has indicated the following possible elements to strengthen:

a) Governance: despite the improvements introduced with the 2021 Communication, the 2023 Code of Practice, and new support tools such as the IPCEI Hub, the governance of the instrument remains complex and fragmented. Coordination is still concentrated in a few large Member States (Germany, France, the Netherlands), creating risks of exclusion. Strengthening and clarifying governance is therefore essential, including through a stronger mandate and additional resources for the Joint European Forum for IPCEI (JEF-IPCEI), so as to ensure systematic monitoring and truly inclusive participation.

b) Geographic asymmetries: A key challenge will be to broaden participation across Member States. Future IPCEIs should avoid being concentrated in a handful of fiscally stronger countries such as Germany, France, and Italy, which currently account for about 70% of all authorised State aid, while other Member States remain absent. Possible strengthening measures include broadening access through the European Competitiveness Fund and cohesion instruments, which can lower entry barriers for fiscally weaker Member States and encourage a wider geographic spread of participation.

c) SME participation: SMEs — although recognised as central to innovation — continue to face high entry barriers, particularly administrative complexity, heavy reporting requirements, and the need to advance significant upfront costs. These obstacles limit their participation to around 20% of beneficiaries on average, despite recent improvements. To strengthen this dimension, procedures could be simplified, clearer guidance provided, and targeted support mechanisms designed (e.g., SME-dedicated calls, lighter reporting templates, and shared facilities). Expanding the role of associated and indirect partners can also help integrate SMEs into the ecosystem without imposing the full burden of direct participation.

d) Financing: The 2028–2034 Multiannual Financial Framework foresees the creation of a European Competitiveness Fund, which—together with cohesion policy instruments and

Horizon Europe—could provide a structured financing base. In this respect the mid-term review of cohesion policy has already reinforced this trajectory by explicitly recognising IPCEIs as eligible for direct support from the ERDF and the Cohesion Fund. This recognition opens the possibility of facilitating access, especially for SMEs and research organisations in Southern and peripheral regions, where fiscal capacity is more limited.

e) National administrative capacity: Member States must reinforce their administrative structures so that they can handle the growing number of IPCEIs without relying on ad hoc solutions. This requires permanent interministerial routines, investment in specialist technical and legal expertise, stability across political cycles, and closer transnational cooperation mechanisms to ensure consistent and timely interaction with the Commission and other Member States. In this regard, access to dedicated EU-level facilities such as the IPCEI Design Support Hub can play a crucial role in providing technical guidance, facilitating coordination, and reducing administrative bottlenecks, thereby complementing national capacity-building efforts.

f) Industry–administration dialogue: Future IPCEIs will require structured and continuous consultation mechanisms between administrations and industry. To be effective, these should not be confined to national champions but should actively include SMEs, research organisations, and regional clusters. Dedicated platforms and regular partnership events can help foster bottom-up proposals and cross-sectoral collaboration, ensuring that new projects respond to real industrial needs and leverage the full breadth of Europe's innovation ecosystem.

In this broader perspective, the challenges identified—governance, inclusiveness, financing, administrative capacity, and structured dialogue—converge on a single point: the success of IPCEIs ultimately depends on the ability of the European Commission to act as a catalyst. By aligning national governments, industry, and Union-level resources, the Commission makes possible projects that no Member State could realise alone. As highlighted in policy debates, its role goes beyond monitoring compliance with State aid rules and extends to orchestrating knowledge, resources, and actors across Europe, transforming fragmented national initiatives into genuine European public goods.[172]Analysts have underlined that making IPCEIs faster, more transparent, and better coordinated is essential to reinforce this catalytic function.[173] Critical assessments also warn that weak

[173] European Policy Centre, *Making IPCEIs a New Vanguard for EU Industrial Policy* [Brussels: EPC, 2023], https://www.epc.eu/publication/Making-IPCEIs-a-new-vanguard-for-EU-industrial-policy-650b30/

governance and limited transparency could undermine effectiveness unless the Commission consolidates its coordinating role.[174]

At the national level, this catalytic dynamic is reflected in the Italian Ministry of Enterprises and Made in Italy decree establishing the IPCEI Fund, which explicitly situates the national instrument within a broader European governance framework.

Strengthening this catalytic role will be decisive in ensuring that IPCEIs evolve into genuinely pan-European instruments, capable of driving competitiveness while also fostering cohesion and inclusiveness across the Union.

[174] Bruegel, *Opaque and Ill-Defined: The Problems of Europe's IPCEI Subsidy Framework* [Brussels: Bruegel, 2022], https://www.bruegel.org/blog-post/opaque-and-ill-defined-problems-europes-ipcei-subsidy-framework

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ANNEXES

ANNEX 1 - Profiles of leading Italian undertakings

Italy's participation in Hy2Tech is grounded in a group of industrial undertakings whose competencies align with the initiative's four Technology Fields (TFs). Each of these actors brings established corporate capacities—ranging from electrochemistry to system integration and transport OEM functions—that position them as credible carriers of hydrogen innovation. Several companies operate across more than one TF: De Nora Italy Hydrogen Technologies (TF1 & TF2); Ansaldo Green Tech (TF1 & TF2); Enel Green Power – NextHy (TF1 & TF3); Fincantieri (TF2 & TF4); Iveco Group (TF4) and Alstom Ferroviaria (TF4).

*TF1 & TF2 - De Nora Italy Hydrogen Technologies***:** A consolidated electrochemical manufacturer with decades of experience in advanced electrodes and coatings. Its corporate profile is that of an industrial player capable of serial production of electrochemical components, supported by robust processes for supplier qualification and industrial quality control. The company anchors Italy's capacity in the upstream generation segment, providing credibility and scale for electrolyser-related manufacturing.[175]

*TF1 & TF2 - Ansaldo Green Tech***:** A technology-led manufacturer within the Ansaldo group, with expertise in scaling laboratory technologies into series production. It benefits from a heavy-engineering tradition, drawing on automation, reliability engineering, and production planning skills. Its corporate positioning reflects a focus on developing and industrialising water-electrolysis solutions with a distinctly domestic production footprint, ensuring national anchoring of electrolyser technologies. [176]

TF2 & TF4 Fincantieri: One of the world's largest shipbuilders, acting as a complex systems integrator. Its competencies span naval architecture, propulsion systems, safety engineering, and maritime certification. As an industrial prime contractor, its corporate profile centres on the ability to

[175] IPCEI Hydrogen Observatory, "De Nora Italy Hydrogen Technologies - Gigafactory (IT17)", Clean Hydrogen Partnership, https://ipcei.observatory.clean-hydrogen.europa.eu/de-nora-italy-hydrogen-technologies-gigafactory-it17-0.

[176] IPCEI Hydrogen Observatory, "Fincantieri (IT13)", Clean Hydrogen Partnership, https://ipcei.observatory.clean-hydrogen.europa.eu/fincantieri-it13-0.

integrate new propulsion technologies into certified, class-compliant vessels—an indispensable capability for fuel-cell applications in the maritime domain.

TF1 & TF3 - Enel Green Power – NextHy: Organised as a dedicated innovation facility within a large utility, NextHy's profile differs from that of manufacturing companies. It acts as a testbed and validator, focusing on system integration, interoperability, and operational benchmarking. Its position within Enel provides access to power-system expertise, allowing it to play the role of a neutral proving ground where hydrogen equipment can be validated against grid-level requirements.[177]

TF4 - Iveco Group: A long-established manufacturer of commercial vehicles, with full OEM capabilities covering vehicle architecture, homologation, and supply-chain orchestration. Its corporate profile is defined by the ability to bring new powertrains—such as hydrogen fuel cells—into production-grade, heavy-duty trucks and buses, ensuring that hydrogen mobility can be scaled into anchored domestic markets.

TF4 - Alstom Ferroviaria: The Italian subsidiary of a global rolling-stock group. It combines manufacturing and engineering capabilities in propulsion integration, train control, certification, and lifecycle support. Its corporate profile positions it as the principal actor for hydrogen traction in rail, adapting proven train platforms to non-electrified lines while meeting stringent safety and reliability requirements. [178]

[177] IPCEI Hydrogen Observatory, "Enel Green Power – NextHy Industrial Lab Innovation Test Facility (IT22)", Clean Hydrogen Partnership, https://ipcei.observatory.clean-hydrogen.europa.eu/enel-green-power-nexthy-industrial-lab-innovation-test-facility-it22.

[178] IPCEI Hydrogen Observatory, "Alstom Ferroviaria Coradia Stream H™ Regional Train (IT43)", Clean Hydrogen Partnership, https://ipcei.observatory.clean-hydrogen.europa.eu/alstom-ferroviaria-coradia-stream-htm-regional-train-it43.

ANNEX 2 - Mapping of the Italian portfolio by Technology Field

Italy's Hy2Tech portfolio demonstrates how national undertakings translate their industrial capabilities into concrete projects across the four Technology Fields (TFs). These initiatives combine industrialisation, demonstration, and integration, while also generating spillover effects in supply chains, regional ecosystems, and research networks.

TF1 & TF2 - De Nora Gigafactory (Cernusco sul Naviglio, Lombardy): De Nora's gigafactory represents a platform investment in serial production of electrolyser components. The project codifies industrial processes for electrodes, cells, and stacks, embedding quality control, traceability, and end-of-line testing within a scalable production environment. By moving from pilot-scale manufacturing to standardised multi-megawatt modules, the facility reduces cost dispersion and shortens delivery times. Its localisation logic is equally significant: Lombardy's specialty-chemicals and precision-mechanics ecosystems are mobilised into a hydrogen hardware supply chain. Spillovers extend to coatings, catalytic layers, separators, and power electronics, creating a distributed base of qualified suppliers able to feed European projects.

TF1 & TF2 - Ansaldo Green Tech – IANUS (Genoa, Liguria): IANUS focuses on industrialising multi-megawatt scale AEM (anion exchange membrane) electrolysers within an Italian production footprint. The project emphasises automation, line integration, and reliability engineering, ensuring the transition from laboratory units to series production. Its significance lies not only in scaling a new electrolyser technology, but also in diversifying beyond conventional PEM and alkaline solutions. Spillover effects include reduced dependence on imported critical materials and the creation of domestic know-how in AEM integration. By situating production in Liguria, the project also extends Hy2Tech's industrial base beyond traditional northern clusters.

TF2 & TF4 Fincantieri – Maritime and stationary applications (Bari & Genoa): Fincantieri's projects cover the design, prototyping, and pre-industrialisation of fuel-cell systems for maritime and stationary contexts. The initiatives focus on marinisation, safety compliance, and integration with vessel energy architectures. The key value lies in ensuring that fuel-cell solutions can be deployed under class rules and operational constraints specific to shipboard environments. Spillovers include the transfer of advanced integration knowledge to Italy's wider shipbuilding ecosystem. By involving suppliers and subcontractors in Apulia and Liguria, the project creates an

industrial pipeline for hydrogen-ready vessels, strengthening the competitiveness of national yards in the global market. [179]

TF1 & TF3 - Enel Green Power – NextHy (Catania, Sicily): NextHy functions as an open-innovation laboratory where interoperability between hydrogen equipment is systematically tested. Its activities include benchmarking of electrolyser performance, validation of operational envelopes for compressors and storage units, and testing of safety protocols. The facility also explores integration with the electricity grid, reducing risks at the interface between hydrogen systems and power networks. Spillovers are considerable: SMEs and research groups can access test data; protocols developed within NextHy contribute to standardisation; and training activities prepare engineers for system-level challenges. The facility thus acts as a neutral proving ground, embedding dissemination and ecosystem duties into a utility context.[180]

TF4 – Iveco Group – Heavy-Duty Road Vehicles (Turin, Piedmont): Iveco's project integrates hydrogen powertrains, high-pressure tanks, and advanced thermal management into heavy-duty trucks and buses. Beyond technical validation, the undertaking establishes homologation processes and adapts supply chains to hydrogen standards. Its importance lies in creating a domestic anchor market where hydrogen mobility can be demonstrated in real-world fleets.

TF4 – Alstom Ferroviaria – Hydrogen Trains (Lombardy & Puglia): The Coradia Stream H™ platform introduces hydrogen traction into regional rail lines. The project involves integration of stacks, storage systems, and energy management into established rolling-stock architectures. Orders from Lombardy and Apulia create immediate domestic demand, ensuring that hydrogen trains move beyond prototypes to commercial service. Spillovers include the establishment of new maintenance hubs, training for railway operators, and the codification of safety and interoperability standards. These effects extend to regional transport ecosystems, embedding hydrogen into everyday mobility infrastructures.[181]

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[179] IPCEI Hydrogen Observatory, "Fincantieri (IT13)", Clean Hydrogen Partnership, https://ipcei.observatory.clean-hydrogen.europa.eu/fincantieri-it13-0.

[180] IPCEI Hydrogen Observatory, "Enel Green Power – NextHy Industrial Lab Innovation Test Facility (IT22)", Clean Hydrogen Partnership, https://ipcei.observatory.clean-hydrogen.europa.eu/enel-green-power-nexthy-industrial-lab-innovation-test-facility-it22.

[181] IPCEI Hydrogen Observatory, "Alstom Ferroviaria Coradia Stream H™ Regional Train (IT43)", Clean Hydrogen Partnership, https://ipcei.observatory.clean-hydrogen.europa.eu/alstom-ferroviaria-coradia-stream-htm-regional-train-it43.

ANNEX 3 - Additional Italian actors in the context of Hy2Tech

In addition to the industrial undertakings profiled in Annex 1 and the specific projects mapped in Annex 2, Italy's Hy2Tech participation relies on a broader set of research centres, public institutions, and academic partners. These actors provide open infrastructures, training initiatives, and knowledge transfer mechanisms that amplify the scope of Hy2Tech and ensure that its benefits extend beyond the direct beneficiaries of State aid.

ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development): the ENEA research network plays a central role in supporting Italy's hydrogen ecosystem. Its Casaccia site near Rome hosts four pilot lines dedicated to different hydrogen applications: production, transport, advanced fuel cells, and hydrogen-based powertrains.
ENEA's function is not commercial manufacturing but rather open technological validation. It offers testing capabilities for both SMEs and large firms, contributes to standardisation, and provides training for engineers and technicians. This positioning makes ENEA an infrastructural backbone, ensuring that technological advances developed under Hy2Tech can be benchmarked and disseminated. Spillovers include structured cooperation with universities, the development of harmonised safety protocols, and the preparation of a skilled workforce.[182]

Fondazione Bruno Kessler (FBK): Located in Trento and Rovereto, FBK complements ENEA by providing regional-scale facilities for applied hydrogen research. Its pilot plants cover electrolysis, hydrogen storage in metal hydrides, and advanced treatment systems, linking laboratory innovation to practical deployment.
FBK's role is to strengthen the regional innovation ecosystem. By opening its facilities to SMEs and universities, it lowers the barriers to entry for smaller actors that could otherwise be excluded from large-scale projects. Spillovers include the diffusion of technical know-how within the Trentino-Alto Adige region, the creation of demonstration environments for industrial partners, and opportunities for collaboration with international research networks.[183]

[182] ENEA, "Energia: con IPCEI idrogeno a ENEA €52 milioni per supporto a filiera industriale," Media ENEA, 25 luglio 2022, https://www.media.enea.it/comunicati-e-news/archivio-anni/anno-2022/energia-con-ipcei-idrogeno-a-enea-52-milioni-per-supporto-a-filiera-industriale.html.

[183] HydroNews, "Bando della Fondazione Bruno Kessler per un sistema di produzione, trattamento e stoccaggio di idrogeno da installare a Rovereto," 16 giugno 2025, HydroNews, https://hydronews.it/bando-della-fondazione-bruno-kessler-per-un-sistema-di-produzione-trattamento-e-stoccaggio-di-idrogeno-da-installare-a-rovereto/.

Italian universities provide critical support for Hy2Tech:

- University of Turin collaborates with ENEA on electrolysis and fuel-cell research, linking academic research to national infrastructure. [184]
- Sapienza University of Rome coordinates the national hydrogen summer school, ensuring training and dissemination at postgraduate level. [185]
- University of Genoa participates in the NEMESI project with Ansaldo, focusing on advanced AEM electrolysers. [186]

These initiatives show how universities contribute to human capital formation. By developing specialised curricula, hosting seminars, and supervising doctoral research, they ensure that Italy's future workforce is equipped with skills tailored to hydrogen technologies.

[184] HydroNews, "ENEA e Università di Torino alleate per studiare le tecnologie dell'H2: i contenuti del primo seminario," HydroNews, 17 novembre 2023, https://hydronews.it/enea-e-universita-di-torino-alleate-per-studiare-le-tecnologie-dellh2-i-contenuti-del-primo-seminario/.

[185] ENEA, "Energia: idrogeno, al via prima Summer School presso il Centro ENEA Casaccia," Media ENEA, 8 September 2022, https://www.media.enea.it/comunicati-e-news/archivio-anni/anno-2022/energia-idrogeno-al-via-prima-summer-school-presso-il-centro-enea-casaccia.html.

[186] HydroNews, "Ansaldo Green Tech e Università di Genova insieme per sviluppare la tecnologia di elettrolisi AEM con il progetto NEMESI," 24 February 2023, HydroNews, https://hydronews.it/ansaldo-green-tech-e-universita-di-genova-insieme-per-sviluppare-la-tecnologia-di-elettrolisi-aem-con-il-progetto-nemesi/.

ANNEX 4 - Emerging ecosystem effects in Italy

Italy's participation in Hy2Tech is generating impacts that extend beyond the scope of individual projects and direct beneficiaries. These ecosystem effects illustrate how State-supported initiatives can influence supply chains, regional development, and human capital. They can be categorised into four main areas: technological, industrial, territorial, and training-related spillovers.

Technological spillovers: The scale-up of electrolyser production has direct implications for Italy's industrial base. De Nora's appointment of Techbau as general contractor for its gigafactory construction demonstrates the industrial relevance of the initiative and the intention to mobilise established Italian engineering and construction firms within the hydrogen value chain.[187]
In Liguria, the industrialisation of AEM technology at Ansaldo Green Tech is already producing concrete market outcomes. The company has secured its first commercial order for a 1 MW AEM electrolyser from CFFT, to be installed at the Civitavecchia freight hub by the end of 2025. The system is designed to produce more than 500 kg of hydrogen per day, with pressurised output, high efficiency, flexibility, reduced reliance on critical raw materials, low-concentration electrolyte, and a smaller water footprint.[188] In addition, Duferco has ordered a 1 MW AEM unit for installation in the Giammoro hydrogen valley in Sicily. These initial deployments demonstrate the capacity of industrial actors to shorten the distance between factory production and field application, thereby consolidating Southern operating environments for TF1 technologies.[189]

Industrial spillovers: In the field of mobility, hydrogen-related initiatives are reshaping supply-chain dynamics. Iveco's hydrogen truck platforms are drawing long-standing Tier-1 and Tier-2 suppliers into domains such as storage vessels, composites, thermal management, and high-voltage power electronics. Likewise, Alstom's regional-rail traction programmes are translating procurement commitments into concrete deployment. The Region of Apulia has placed Italy's first order for hydrogen trains, complementing Lombardy's existing framework. These initiatives are generating

[187] HydroNews, "De Nora sceglie Techbau come general contractor per la costruzione della sua gigafactory di Cernusco sul Naviglio," 6 September 2024, https://hydronews.it/de-nora-sceglie-techbau-come-general-contractor-per-la-costruzione-della-sua-gigafactory-di-cernusco-sul-naviglio/
[188] HydroNews "Ansaldo Energia vende il suo primo elettrolizzatore AEM all'azienda logistica CFFT, che lo installerà a Civitavecchia," November 21, 2024, https://hydronews.it/ansaldo-energia-vende-il-suo-primo-elettrolizzatore-aem-allazienda-logistica-cfft-che-lo-installera-a-civitavecchia/

[189] HydroNews "Duferco commissiona ad Ansaldo Energia un elettrolizzatore AEM da 1 MW per la sua hydrogen valley di Giammoro, in Sicilia," n.d., https://hydronews.it/duferco-commissiona-ad-ansaldo-energia-un-elettrolizzatore-aem-da-1-mw-per-la-sua-hydrogen-valley-di-giammoro-in-sicilia/

opportunities in maintenance, safety validation, and component localisation, reinforcing rail-sector adaptation to hydrogen technologies.[190]

Industrial spillovers are also visible in maritime applications. Fincantieri has inaugurated a dedicated hydrogen fuel cell production line at Isotta Fraschini Motori (IFM) in Bari, thereby strengthening Italy's TF2 capabilities. Located within IFM's Innovation and Development Center, opened in 2023, the new line has been equipped for end-to-end development and validation of marinised stacks and balance-of-plant systems, enabling the transition from engineering trials to type testing and pre-series production within a single controlled environment. Structured as a five-year €30 million programme with Hy2Tech co-financing, the initiative positions Fincantieri as the first user of the technology, reducing industrialisation risks. A headline demonstrator will be the installation of an IFM fuel-cell module on the cruise ship Viking Libra, the first vessel of its kind to store and use hydrogen on board for propulsion and hotel loads. This project is expected to address certification processes, ventilation and enclosure safety, hybridisation with existing electrical architectures, and maritime reliability standards.[191]

Territorial spillovers: The Italian portfolio reflects a deliberate North–South division of labour. Northern regions, notably Lombardy, Liguria, and Piedmont, remain concentrated centres for manufacturing and engineering, particularly for electrolyser production, automotive integration, and maritime system design. Southern regions, including Apulia and Sicily, are emerging as deployment theatres for early applications. The Civitavecchia freight hub and the Giammoro hydrogen valley provide demonstration platforms for TF1 outputs, while Bari hosts Fincantieri's new production line and Apulia has initiated the country's first procurement of hydrogen-powered trains.

This territorial articulation ensures that IPCEI-supported investments contribute not only to the reinforcement of established industrial districts but also to the upgrading of emerging regions. By stimulating employment, infrastructure, and operational expertise in the South, Hy2Tech strengthens cohesion and broadens the geographic reach of the Italian hydrogen ecosystem.

[190] H2Tech "Alstom to supply first hydrogen trains to the Italian region of Puglia," January 2024, https://h2-tech.com/news/2024/01-2024/alstom-to-supply-first-hydrogen-trains-to-the-italian-region-of-puglia/

[191] Fincantieri, "Gruppo Fincantieri: Isotta Fraschini Motori inaugura a Bari la nuova linea produttiva Fuel Cell," press release, July 21, 2025, https://www.fincantieri.com/it/media/comunicati-stampa-e-news/2025/gruppo-fincantieri-isotta-fraschini-motori-inaugura-a-bari-la-nuova-linea-produttiva-fuel-cell/.