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Green Deals around the World

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Abstract: This essay examines the rise of "Green Deals" as large-scale state-sponsored active industrial policies to accelerate a transition toward climate neutrality. Building on the concept of mission-oriented innovation policy (MOIP), it documents how environmental and active industrial policies have converged across advanced economies, reshaping the policy toolkit toward direct public investment and publicly supported investment. The essay provides detailed accounts of the European Union's Green Deal and the U.S. counterpart, situating them in the broader political economy of climate policy. It also highlights initiatives in the United Kingdom, Germany, and Sweden, which additionally illustrate Grean Deal initiatives and how the latter national strategies adapt EU-level frameworks and institutional constraints. A comparative analysis underscores key differences between the EU's fragmented, case-by-case approach and the more streamlined but fiscally uncertain U.S. model. The essay concludes by stressing the need for greater scrutiny of these policies, including their economic efficiency and fiscal sustainability.

Keywords: Climate neutrality, Climate policy, Green Deal, Mission-oriented innovation policy, Industrial policy,

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Introduction

Addressing climate change caused by rising greenhouse gas emissions has become a central concern for policymakers worldwide. Political leaders face growing demands from voters and media for decisive action, and climate policy has risen to the top of political agendas. Whereas environmental policy historically relied primarily on taxation, regulation, and prohibitions to promote sustainability, recent years have witnessed a convergence of environmental and industrial policy. Increasingly, governments initiate large-scale, state-sponsored industrial investments through an active industrial policy framework.

This renewed interest in industrial policy has been reinforced by economists such as Mariana Mazzucato and Dani Rodrik, who argue for a more proactive role for the state in shaping markets and directing economic development (e.g., Mazzucato, 2018a, 2021; Rodrik, 2022). Under the concept of "mission-oriented innovation policy" (MOIP), Mazzucato advocates for governments to guide economies toward socially desirable goals, including sustainability, inclusiveness, and resilience. Drawing on historical examples such as the American Project Apollo, she has succeeded in reshaping how many policymakers and public commentators conceive of the government's role in fostering innovation.

Mazzucato has also suggested that "Green New Deals" constitute a paradigmatic mission suitable for large-scale political intervention (Mazzucato, 2021, p. 137ff). These ideas have inspired politicians and organizations worldwide to promote ambitious green industrial strategies under the labels of Green Deals or Moonshots.[1] Illustratively, European Commission President Ursula von der Leyen described the European Green Deal as Europe's "man on the moon moment," while U.S. Energy Secretary under the Biden administration, Jennifer Granholm, has called the fight against climate change "our generation's moonshot."[2]

Although the urgency of the climate challenge is widely acknowledged, these large-scale programs are being implemented across many Western countries with limited critical scrutiny (Henrekson et al., 2024). Academic analyses remain relatively scarce, particularly regarding the risks of failure and unintended consequences of MOIPs. To scrutinize these ideas and policies, a necessary first step is to map the scope, structure, and design of the emerging green industrial policies that fall under the umbrella of Green Deals.

[1] See, e.g., Mazzucato (2018b, 2019), which are two reports written for the European Commission recommending the European Union to use a mission-oriented research and innovation approach.
[2] See von der Leyen (2019) and Granholm (2022) for the quotes.

Hence, the aim of this essay is to examine the structure and extent of Green Deals around the world. The analysis focuses in particular on the European Union and the United States, where Green Deal initiatives have expanded most rapidly and provided inspiration for other countries, but selected cases from other Western economies—the United Kingdom, Germany and Sweden—are also briefly discussed.[3]

The essay proceeds with a brief theoretical discussion of the evolution of innovation policy, highlighting the shift from market- and system-failure perspectives to a broader societal-mission orientation. This is followed by a description of the European Green Deal and the U.S. case. Thereafter, examples from the individual countries are presented, before the essay concludes with a short comparative analysis and general conclusions.

Innovation Policy—A Historical Background

The recent surge in support for large-scale government intervention has not arisen in a vacuum. Before turning to the structure of Green Deals around the world, this section briefly reviews the evolution of innovation policy and explains how the renewed popularity of active industrial policy—of which Green Deals are a prime example—emerged.

The first generation of innovation policy: market failure

The earliest approaches to innovation policy are often described as a "first generation" of thinking, grounded in neoclassical economics and the concept of market failures. In this perspective, markets were assumed to allocate resources efficiently under some ideal pre-determined conditions, but in the case of innovation such conditions often did not hold. Knowledge, in particular, was considered a public good. i.e., it was non-rivalrous and, at least partly, non-excludable, which meant private actors tended to underinvest in research and development (R&D), as they could not fully appropriate the returns (Nelson, 1959; Arrow, 1962). In other words, knowledge was characterized by having positive externalities, which meant that the social benefits of new knowledge were greater than the individual benefits for those who produced the knowledge.

The first generation of innovation policy thus viewed the role of government primarily as a corrective actor solving market imperfections. This entailed interventions such as subsidies for R&D, public funding of basic research, provision of education and skills, and the

[3] Apart from the countries covered by this study, only a handful of other developed economies—namely Canada, Australia, New Zealand, South Korea, Switzerland, Lichtenstein and Iceland—have enacted legislation committing to climate neutrality ("net zero") by 2050 (Energy and Climate Intelligence Unit 2025).

establishment of intellectual property rights regimes. The underlying linear logic was that the state should "fix the market" where it fails to generate socially optimal levels of investment in knowledge production and diffusion (Smith, 2000).

This market-failure perspective was highly influential in the postwar decades, shaping innovation policies in the OECD countries from the 1960s onwards. For example, large-scale public investments in research laboratories and universities, along with direct R&D subsidies to firms, were justified as mechanisms to correct for the under-provision of innovation in purely market-based systems (OECD, 1998).

The second generation of innovation policy: system failure

A second generation of thinking emerged in the 1980s inspired by Nelson and Winter's (1982) evolutionary economics perspective. Their perspective contrasted with the traditional neoclassical approach by emphasizing routines and firm heterogeneity. Central to their argument was the notion that technological change was path-dependent and shaped by prior investments, learning processes, and industrial structures.

Building on these insights, scholars began to criticize the narrow market-failure framework of first-generation innovation policy, instead advocating an "innovation systems" perspective—which can be considered a second generation of innovation policy theory (Freeman, 1987; Lundvall, 1992; Nelson, 1993). This theory emphasized that innovation was not an isolated linear activity within firms, but the outcome of complex interactions among firms, universities, public agencies, users, and other institutions. Failures were thus not only about markets underproviding knowledge, but also about weaknesses in the systems that enable innovation. This approach gave rise to the concept of system failures, where governments were tasked with improving the structure and functioning of innovation systems (Woolthuis et al., 2005).

With this perspective, innovation policy was no longer narrowly limited to subsidizing R&D or correcting underinvestment, but expanded to encompass factors such as facilitating coordination, fostering linkages between knowledge creation and commercialization, and shaping institutions. In practice, this meant that policy instruments under the second generation stressed cluster programs, support for collaborative R&D projects, technology transfer offices, and networking platforms. The emphasis moved from correcting underinvestment in knowledge toward enabling interactive learning and fostering the institutional conditions under which innovation could thrive.

The third generation of innovation policy: societal failure

The third generation of innovation policy emerged in response to mounting global challenges such as climate change, biodiversity loss, and widening social inequalities. While the second-generation, system-failure perspective focused on strengthening networks and institutions, it was criticized for lacking direction and failing to ensure that the innovations contribute to societal transformation addressing alleged societal challenges (Schot & Steinmueller, 2018). This recognition has given rise to an orientation toward transformational and societal failures—problems that arise when innovation systems remain locked into unsustainable trajectories and fail to generate the radical changes needed for long-term sustainability.

At the heart of third generation thinking lies the argument that markets and systems tend to reinforce existing structures only favoring incremental innovation, and thereby potentially locking-in societies in unsustainable regimes. Governments are therefore called upon not merely to correct market and system failures but to provide directionality—actively shaping innovation pathways and guiding economies toward sustainability.

With slightly different terminology and emphasis, several different strands of literature and a large number of scholars have—in line with the third generation—pointed to a pressing need for an expanded role of innovation policy, particularly in supporting the green transition. Mazzucato's work on Mission-Oriented Innovation Policy (MOIP), highlighted in the introduction, belongs to this intellectual tradition underscoring that solving the climate challenge requires more deep-seated political involvement in the economy. Jacobsson et al. (2017) is another example criticizing the European Commission's earlier emphasis on market failure, system weakness, and technological neutrality, arguing that such a narrow focus neglected the need for more transformative and directional policies. This type of criticism helped pave the way for the launch of the European Green Deal, which explicitly embraces a stronger political role in guiding innovation policy.

Summary

Over time, innovation policy scholarship has shifted from talking about correcting market failures, to addressing system failures, and finally to confronting societal failures. The trajectory reflects a growing emphasis on market creation and the proactive shaping of new industries and technological pathways. The literature on innovation policy has grown rapidly and over time and it has increasingly advocated a more interventionist approach to

policy, where governments are expected not only to support innovation but to steer it toward a sustainable future. The proliferation of Green Deals worldwide is a case in point, embodying a belief in the necessity of extensive state involvement to guide societies toward climate neutrality.

The European Green Deal

General background

In December 2019, the European Commission announced the so-called European Green Deal, a set of goals, regulations, and policies aiming to combat climate change while keeping the EU competitive and ensuring social and political sustainability. The overall goal was to reduce greenhouse gas emissions and transform the EU into the first climate-neutral continent by 2050. In order to accelerate the process, an intermediate goal to reduce greenhouse gas emissions by 55% by 2030 (compared to the 1990 level) was laid down together with additional policies and regulation under the so-called Fit for 55 package in July 2021.

The European Green Deal can be seen as an umbrella for all policies and regulations, including binding targets of national annual greenhouse gas emissions and of renewable energy in the energy-mix, deemed necessary to reach the overarching goal of climate neutrality ("net zero"). The initiatives have expanded over time, and it is impossible to give an exhaustive list of all policies covering different sectors, firms, technologies, and products. Examples include objectives such as expanding the use of decarbonized and sustainable fuels in aviation and shipping, achieving the complete phase-out of vehicles with tailpipe emissions, and advancing policies to improve energy efficiency in buildings. In 2024, the Net-Zero Industry Act was also adopted to ensure expedited administrative procedures and accelerated approval processes for clean technology industries located inside EU borders.

But the European Green Deal is more than just regulation and policies. An important part of the Deal is about spending. The investment pillar of the Green Deal is denoted the Green Deal Investment Plan. Initially, the EU drew up an ambitious plan of mobilizing funds of EUR 1 trillion through different forms of initiatives—and this amount refers only to funds needed for the first decade under the Green Deal (European Commission, 2020a). Later assessments suggest that the Union must make climate-related investments amounting to EUR 1,200 to 1,300 billion annually until 2030, and even more thereafter, in order to achieve net zero by 2050 (see, e.g., discussion in Pons & Madec, 2024 or Andersson et al., 2025). It is important to note that this figure does not refer to direct public investment only, private investment must

also be part of the solution, but its level is supposed to be increased through different forms of public guarantees and subsidies. Based on different estimations, the private share of the required increase of investment is appraised to be 50 to 75% (Pisani-Ferry & Tagliapietra, 2024).

The structure of support

The European Union has traditionally taken a restrictive stance toward national state aid, given the risk that such support could distort competition among firms across member states. However, in response to the COVID-19 pandemic and the war in Ukraine, these constraints were temporarily relaxed. In pursuit of the EU's overarching sustainability and climate-neutrality objectives, the possibility to give state aid was later prolonged and modified, permitting member states to provide extensive public funding to support the green transition (a framework denoted the Temporary Crisis and Transition Framework, TCTF, which was extended in 2025 as the Clean Industrial Deal State Aid Framework, CISAF). As larger countries possess greater fiscal capacity, complementary industrial support at the EU level is seen as crucial to prevent distortion and fragmentation within the Single Market. Accordingly, spending at the federal EU level is considered essential and both the scope and scale of EU-level spending have recently expanded substantially. Much of the EU spending is supposed to trigger or require co-financing by member states. Public support for the green transition is therefore financed through a combination of national budgets and the EU budget. Estimates suggest that roughly one-third of green funding is centrally managed at the EU level, and the remainder being allocated nationally through member state plans (Pisani-Ferry & Tagliapietra, 2024).

As a result of the rapidly increasing funds that are supposed to be spent on the green transition, a new agency, the European Climate, Infrastructure and Environment Executive Agency (CINEA), was established in 2021 in order to support, coordinate and help implement the Green Deal. Today, the agency employs nearly 600 bureaucrats and experts and is projected to expand further.[4]

The funds are often paid out through different forms of programs, such as Horizon Europe. Horizon Europe is EU's key funding program for research and innovation. The program supports so-called "moonshot scientific-driven projects," which underscores the connection to

[4] For more information see the homepage of CINEA at https://cinea.ec.europa.eu/index_en.

the concept of mission-oriented innovation policy with publicly targeted support discussed in the introduction.[5]

Highlighting the revitalized idea that politicians and bureaucrats have the ability to "pick the winners" by supporting what they see as key technologies necessary to succeed with the green transition, some of the support is directly targeted at specific solutions or companies. A prime application of this idea is the European Union's adoption of a hydrogen strategy in July 2020 to stimulate the use of hydrogen as a key means to achieve climate neutrality, and the subsequent launch in 2022 of the European Hydrogen Bank—an instrument designed to support the scale-up of hydrogen production by financing selected projects.[6]

Within so-called IPCEI (Important Projects of Common European Interest), member states can also cooperate and support specific projects that are deemed to significantly benefit the EU. A centrally managed EU IPCEI fund does not exist, but the Commission has so far approved state-aid support for 11 IPCEIs, including funding for hydrogen and battery projects. Granted national state aid plus expected private investment within these projects added up to almost EUR 100 million by mid-2025 (European Commission, 2025d).

To mobilize the necessary resources, the European Union has introduced a broad range of instruments—including grants, public co-financing, subsidies, and guarantees—designed to diversify the channels of support. In response to the pandemic, the EU established the Recovery and Resilience Facility (RRF), initially to assist member states in need but subsequently expanded its scope to include support for the green transition. At least 37% of RRF expenditure must be directed toward climate-related measures (Pisani-Ferry & Tagliapietra, 2024; Pons & Madec, 2024). To finance the RRF, the EU has, for the first time, borrowed jointly in capital markets (e.g., by issuing so-called green bonds). Part of the RRF is used to support other initiatives, such as NextGenerationEU and RePowerEU, with funds. A so-called Just Transition Mechanism is also part of the system and is supposed to alleviate the negative effect that might hit certain regions harder than others due to the transition. It should be noted that the treaties do not confer upon the European Union a general authority to impose taxes directly—the power

[5] For the period 2028–2034, the Commission has proposed a EUR 175 billion budget for Horizon Europe (European Commission 2025a). See European Commission (2025b) for possible EU moonshot projects that could be financed by these funds, and European Commission (2025c) for information about adapting to the climate change as an EU mission.

[6] See European Commission (2020b, 2023a) for more information. The trade body Hydrogen Europe estimated that it would require EUR 430 billion to scale up the EU's hydrogen sector by 2030. New estimates suggest that investments equaling at least EUR 320 billion is needed by 2030 (European Hydrogen Observatory, 2025).

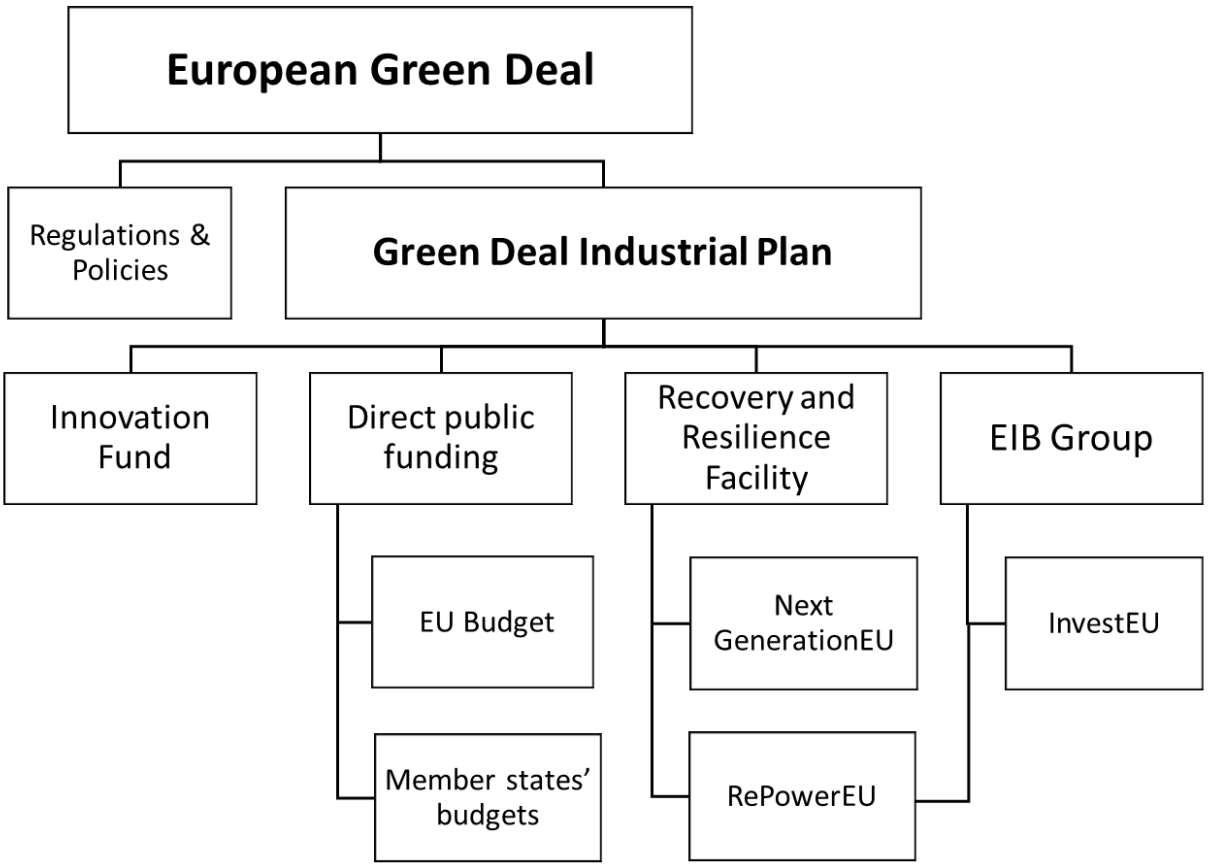
to tax rests with individual member states. As a result, the EU cannot give tax credits to corporations or households to stimulate green investments.

Additional financing is provided through revenues from the EU Emissions Trading System (ETS), the cap-and-trade mechanism for greenhouse gas emissions. These revenues fund, *inter alia*, the Innovation Fund, which supports projects facilitating the transition to climate neutrality.

Beyond these funds, the European Investment Bank (EIB), formally a distinct body independent from other EU institutions, has designated climate and environmental sustainability as its primary priority. The EIB devotes more than 50% of its lending towards projects supporting the green transition and has committed to support green investments amounting to EUR 1 trillion until 2030 (Pisani-Ferry & Tagliapietra, 2024; Pons & Madec, 2024). Complementing this is the InvestEU program, which employs public funds and guarantees to lower the costs and risks of private investments in priority sectors, including green endeavors.

To get a grasp of the complexity of the system, Fig. 1 schematically maps the Green Deal and its public support system. The goals and funds of these sources are partly overlapping and summing up all the amounts spent that is reported within the different programs and budgets would result in double counting. However, the EU's seven-year budget together with the NextGenerationEU recovery plan includes investment totaling EUR 1.8 trillion and one-third of this amount is designated to Green Deal investments (European Commission, 2024a). A more detailed description of the support system is presented in the Appendix.

Fig. 1 The EU Green Deal and the most important parts of the public support system



The U.S. Green Deal: The Inflation Reduction Act (IRA)

General background

In August 2022, the United States, under President Joe Biden, enacted the Inflation Reduction Act (IRA)—a somewhat misleading title for what was in fact the largest public climate-related investment initiative in U.S. history.[7] The U.S. climate target, established in April 2021, was to halve greenhouse gas emissions relative to their 2005 level by 2030.[8] Estimates suggest that the IRA would reduce national carbon emissions by approximately 1 billion metric tons until 2030, thereby closing about two-thirds of the gap toward the climate target that would persist without any further actions (Jenkins et al., 2022). Together with complementary regulations and policies, the legislation aimed not only to reduce national carbon emissions by 2030, but

[7] The IRA also includes other parts not associated with environmental challenges, notably measures related to the healthcare and medical system.
[8] Cf. EU's target of reducing greenhouse gas emissions by *55%* by 2030 relative to the *1990 level*.

also to strengthen competitiveness, foster innovation, and raise productivity (Jiang et al., 2022; McKinsey, 2024).[9]

The IRA provided approximately USD 500 billion in new spending and tax incentives, of which approximately USD 400 billion was earmarked for environmental projects to be implemented over a ten-year period. It should also be noted that the Biden administration advanced other major investment programs, most notably the Bipartisan Infrastructure Law (BIL) and the CHIPS and Science Act (CHIPS), which resulted in a total value of new commitments of more than USD 2 trillion (roughly 7.7% of U.S. GDP in 2022) over the same time period (McKinsey, 2024).[10]

The IRA employs multiple instruments to address the climate challenge, including tax incentives, grants, and loan guarantees. The majority of the funds are directed toward tax credits designed to accelerate the deployment of renewable energy and energy-efficiency systems. Additional resources are allocated to clean energy financing and other targeted initiatives (Bertrand, 2022). As will be described below, many of these programs were, however, halted or suspended following Donald Trump's assumption of office in 2025.

According to estimates by McKinsey (2024), roughly two-thirds of the public federal support under IRA is allocated to various tax incentives, of which most parts target corporations. Slightly more than 20% is directed towards grants, while just over 10% is provided through different forms of loan support.

To finance the Green Deal initiative, the Administration increased the minimum corporate tax on large corporations and initiated cost savings within the health care sector, among other things. According to the Congressional Budget Office's initial estimates the IRA was not expected to be underfinanced—on the contrary, it was projected to generate a surplus contributing to deficit reduction (CRFB, 2022).

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[9] The whole Act is available at https://www.congress.gov/bill/117th-congress/house-bill/5376.
Earlier initiatives, such as the Build Back Better Act, also aimed to reduce emissions, though on a smaller scale than the IRA.

[10] Other estimates suggest that IRA provides funds for climate and clean energy provisions amounting to around USD 370 billion (Dings & Sol, 2025). The uncapped design of part of the support system (mainly tax credits) makes it difficult to predict the final level of expenditure, as it ultimately depends on the scale of production and investment, and on the amount of support claimed by firms and individuals. Credit Suisse estimates that public support could exceed USD 800 billion. Moreover, accounting for multiplier effects, they claim that the total investment stimulus could reach USD 1.7 trillion (Jiang et al., 2022). Other estimates suggest even higher figures.

Key components of the IRA

Fig. 2 provides a schematic overview of the key components of the IRA. Tax credits and deductions fall under the authority of the U.S. Department of the Treasury and encompass a wide range of instruments. Consumer-oriented credits include support for electric vehicles, rooftop solar panels, and heat pumps. Producer-oriented credits similarly target, e.g., manufacturers of renewable energy components, such as battery cells and solar or wind energy equipment.[11] Unlike many grant-based schemes, manufacturers are not required to submit applications—if eligible, they can just claim the credits directly on their tax returns. (However, if requested, they must be able to present valid documentation). The credit amount is often based on the production output (production tax credits, PTC) or investment amount (investment tax credits, ITC).[12] The tax credit support system is not subject to the ordinary annual appropriations implying that the fiscal cost is uncapped and will vary with uptake (for information about tax credits, see EPA, 2025a).

To incentivize domestic production, many forms of support require that eligible firms produce or assemble the subsidized items within the United States, and that they incorporate domestic inputs—such as American rare earth metals or batteries—into their production processes (Dings & Sol, 2025).[13]

Even if the key component of the IRA is tax credits, there are other parts as well. The U.S. Department of Energy's Loan Programs Office (LPO) provides financial support for the green transition, primarily through subsidized direct loans and loan guarantees. The IRA expanded the LPO's lending authority more than tenfold, to over USD 350 billion. The LPO primarily targets *large-scale* projects that traditional lenders may be unable to finance due to debt-capacity constraints or may decline to support because of perceived risks. For example, the LPO gave a loan guarantee exceeding USD 500 million for a hydrogen and energy storage facility in Utah (Jiang et al., 2022; McKinsey, 2024).

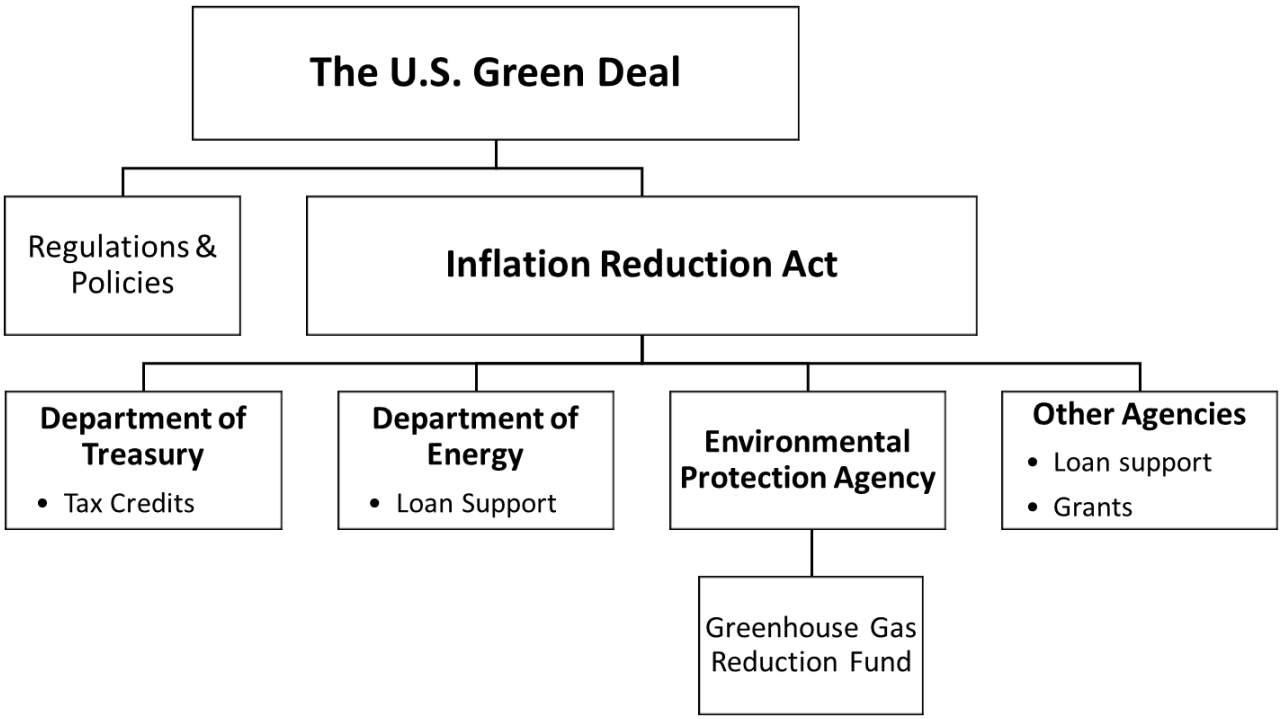
[11] Tax credits existed well before the IRA was in place, but the scope and size increased substantially following IRA due to extensions, modifications and new programs. In addition to tax credits, there is also a system of enhanced tax deductions linked to improvements in the energy efficiency of commercial buildings.
[12] Since 2025, the tax credit system no longer targets specific technologies or industries. Instead, the tax credits apply broadly to all generation facilities and energy storage systems with an anticipated greenhouse gas emissions rate of zero.
[13] In addition, there are often also wage and apprenticeship requirements implying that the supported corporations must pay prevailing wage rates and employ apprentices from registered apprenticeship programs in order to receive the maximum tax credit (IRS, 2025).

The IRA also authorized the U.S. Environmental Protection Agency (EPA) to establish the Greenhouse Gas Reduction Fund (GGRF), with a budget of USD 27 billion, aimed at stimulating projects that reduce emissions and pollution, particularly in low-income and disadvantaged regions, while also mobilizing capital for green investments. Unlike the LPO, the GGRF is designed to support primarily *small-scale* investments, small businesses, and low-income communities. A portion of the funds is directed to nonprofit green banks, which leverage private capital to finance smaller green projects often underserved by commercial banks due to scale and risk considerations.[14] Hence, both the LPO and the GGRF are intended to support green projects that conventional financial intermediaries may view as too risky or unsuitable in scale—either too large, as in the case of the LPO, or too small, as in the case of the GGRF.

The IRA also encompasses a wide range of additional support programs administered by other agencies. For example, it allocates funds to the U.S. Department of Agriculture to provide grants and loans for rural electricity generation and storage projects. Funds have also been allocated to the National Oceanic and Atmospheric Administration (NOAA), which administers competitive grants to organizations engaged in, e.g., strengthening resilience to weather- and climate-related events. However, a detailed account of all these initiatives is beyond the scope of this essay.

[14] The GGRF consists of three components: the National Clean Investment Fund, the Clean Communities Investment Accelerator, and the Solar for All program. For further information of GGRF, see EPA (2025b).

Fig. 2 The U.S. Green Deal: The most important parts of the public support system



IRA after Donald Trump took office

On his first day in office, January 20, 2025, President Trump issued an Executive Order which instructed all agencies to immediately stop disbursing funds associated with the IRA and to review the processes for issuing grants, loans, and other allowances. The White House Office of Management and Budget followed up by requiring all agencies to temporarily pause all grant, loan, and financial assistance programs.[15] Formal climate targets were also abandoned as the United States withdrew from the Paris agreement.

Furthermore, several individual programs were directly shut down. On March 20, 2025, a Trump-appointed EPA Administrator terminated the lion's share of the Greenhouse Gas Reduction Fund by closing down the National Clean Investment Fund and the Clean Communities Investment Accelerator Program (which constituted USD 20 billion of the 27 billion fund) claiming that those programs were associated with "fraud, waste and abuse" and that EPA should not be "a frivolous spender in the name of 'climate equity'" (EPA, 2025c).

On July 4, 2025, President Trump signed the One Big Beautiful Bill Act, under which many environment-related tax credits were either repealed or phased out, particularly consumer-

[15] Executive Order 14154 ("Unleashing American Energy"), see https://www.whitehouse.gov/presidential-actions/2025/01/unleashing-american-energy/.

focused provisions such as the electric vehicle tax credit. However, some credit facilities were expanded—notably those related to clean fuel production and carbon dioxide sequestration (Tax Foundation, 2025). Lawsuits and court decisions seeking to compel the Administration to unfreeze funds have followed President Trump's actions, and it remains uncertain what will happen with the IRA going forward.

Green Deals in Other Countries

The United Kingdom

In November 2020, the UK government under Prime Minister Boris Johnson announced the Ten Point Plan for a Green Industrial Revolution, aimed at supporting green jobs and accelerating the reduction of greenhouse gas emissions to achieve net-zero by 2050. The plan was to fund GBP 12 billion in government investment, with the expectation of mobilizing as much as three times that amount in private-sector funding, by 2030. To begin with, the goal was to reduce UK emissions by 180 million metric tons of carbon dioxide until 2032 (GOV UK, 2020, 2021).

The Ten Point Plan encompasses targeted key areas with support to offshore wind, hydrogen, nuclear power, zero emission vehicles, green public transportation, sustainable aviation and maritime technologies, and carbon capture. The last two points of the plan referred to protecting the natural environment and establishing a green financing program. The latter program raises financing through different forms of green bonds issued by the government to fund green government expenditures in the form of direct investment, subsidies, or tax foregone (HM Treasury, 2023).

The core ambition of the Ten Point Plan has largely been maintained under successive governments. Boris Johnson's successor as Prime Minister, Rishi Sunak, adopted a more pragmatic and cautious approach. By emphasizing affordability, scaling back certain goals, and reviewing costs, his government slowed the pace of regulatory initiatives and the rollout of grants. Under the Prime Minister at the time of writing, Keir Starmer, there has been stronger alignment with the original plan's ambition, accompanied by the goal of making the UK a "clean energy superpower" (GOV UK, 2024a).

New initiatives have also been introduced. Most notably, the Great British Energy Act of 2025 established Great British Energy (GBE), a state-owned company with a mandate to invest in clean energy generation and expand "home-grown" clean power, capitalized with GBP 8.3

billion. In addition to pursuing its own projects, GBE is designed to act as a co-developer with private firms and local authorities, helping to de-risk projects—particularly at the development stage—with the aim of mobilizing private capital (GOV UK, 2024b). To launch its activities, the company was allocated GBP 25 million to establish its headquarters in Aberdeen (HM Treasury, 2024). Its initial priorities covered projects such as offshore wind development, but it will also support nuclear power (including SMR technology).

Germany

In 2021, Germany amended the Climate Action Act (*Klimaschutzgesetz*) to introduce legally binding rules committing the country to achieve climate neutrality by 2045. The Act set intermediate targets of reducing greenhouse gas emissions by 65% by 2030 relative to 1990 levels, and by 88% by 2040. Achieving the 2045 climate neutrality target is estimated to require total investment of around EUR 5 trillion, of which approximately EUR 500 billion is expected to come from public sources (European Parliament, 2024a).

Germany's long-term strategy under the label *Energiewende* has been to shift away from fossil fuels and nuclear energy toward renewable energy and greater energy efficiency, with the overarching objective of achieving climate neutrality. Nuclear power was fully phased out in 2023, and coal is to be phased out no later than 2038.[16]

The German federal state employs a mix of regulatory instruments and financial support to promote the transition. As a member of the European Union, many of these instruments align with EU-level frameworks. Domestic measures include grants and investment support provided, e.g., through the Federal Office for Economic Affairs and Export Control (*Bundesamt für Wirtschaft und Ausfuhrkontroll*, BAFA), as well as loans and concessional financing from the state-owned development bank KfW (*Kreditanstalt für Wiederaufbau*), which plays a central role in funding green projects (BAFA, 2025; KfW, 2023).

A flagship role in the German government's financing of projects related to the country's energy and climate transition is held by the Climate and Transformation Fund (*Klima- und Transformationsfonds*, KTF). Originally created in 2010, it was substantially expanded under the Social Democratic led coalition government formed in 2021, investing in renewable energy and green technologies such as hydrogen and electromobility. Public funding through KTF is expected to be complemented by substantial private investment.

[16] See Deshaies (2026) for more information about *Energiewende*.

For the 2024–2027 period, the KTF was allocated more than EUR 200 billion (roughly 4.6% of German GDP in 2024), financed from federal sources (BMWE, 2023). However, in November 2023 the Federal Constitutional Court ruled that the government's financing plan for KTF violated the constitutional "debt brake" and the constitutional limit on federal debt, forcing a substantial cutback in the size of the fund (European Parliament, 2024a).[17] In 2025, the new Christian Democratic led government introduced a new EUR 500 billion Infrastructure and Defense Fund. To bypass the constitutional limit and secure sufficient parliamentary support, notably from the Green Party, the government agreed to earmark 20% of the fund for climate projects. As a result, EUR 100 billion was transferred to KTF, which supplied the fund with substantial resources to continue supporting green projects (Clean Energy Wire, 2025; ESG Lore, 2025).

Sweden

In 2017, Sweden adopted its current Climate Policy Framework (in force since January 1, 2018), which introduced the Climate Act with legally binding climate targets and the long-term objective of achieving net-zero greenhouse gas emissions by 2045. Intermediate targets require emission reductions of 63% by 2030 and 75% by 2040, relative to 1990 levels (Government Offices of Sweden, 2021; European Parliament, 2024b).

An important element of Sweden's support system is *Klimatklivet* ("the Climate Leap"), an investment grant program administered by the Swedish Environmental Protection Agency (*Naturvårdsverket*). Established in 2015, *Klimatklivet* provides subsidies covering up to 50% of investment costs for non-household projects that reduce greenhouse gas emissions. Since its inception, *Klimatklivet* has allocated nearly SEK 20 billion (≈ EUR 1.8 billion) to more than 27,500 green investments across the country (Naturvårdsverket, 2025).

Industriklivet ("the Industry Leap"), launched in 2018, channels support more directly toward industrial technology transitions by financing research, development, pilot projects, and first-of-a-kind industrial decarbonization investments. Through 2024, *Industriklivet* had distributed SEK 7.4 billion in public grants. Together with co-financing from project partners, the total mobilized investment amounted to nearly SEK 100 billion (≈ EUR 9 billion) (Energimyndigheten, 2025).

[17] The problem with the KTF funding contributed to government's collapse in November 2024.

In addition to grants, Sweden employs other instruments. The National Debt Office (*Riksgälden*) was mandated in 2021 to issue credit guarantees for large industrial green investments, covering up to 80% of loan values, with a framework of SEK 80 billion (≈ EUR 7.7 billion; roughly 1.25% of Sweden's GDP in 2024) authorized by the end of 2024 (Riksgälden, 2024). A prominent case was the EUR 1.2 billion loan guarantee for H2 Green Steel's new plant in Boden (Riksgälden, 2023).[18] Publicly supported green loans are also available, for instance through the state-owned company *Almi*, which may offer loans with amortization relief and lower interest rates to small and medium-sized corporations (Almi, 2025).

In the same way as with Germany, the support aligns with the EU-level frameworks and often uses funds from the EU system. Both *Klimatklivet* and *Industriklivet* are partly financed through the EU's *NextGenerationEU* instrument, and *Almi* is supported by InvestEU funds, which are described above.

Comparative Analysis

Although the European and U.S. systems share the overarching goal of reducing greenhouse gas emissions and addressing climate change, they differ in several significant ways. Compared to the European Union, the U.S. Green Deal, as depicted by the IRA, is less fragmented and more output oriented. Subsidies under the IRA are more rules-based and open-ended, not tied to project-specific viability assessments, whereas EU subsidies are more case-specific and often based on an alleged funding gap, designed (in theory) to prevent overcompensation and to comply with state-aid law. A substantial share of the IRA provisions are uncapped and operate outside the annual appropriations process, meaning that support is not constrained by predetermined budgetary limits. The IRA is also strongly origin-based, requiring domestic production or assembly within the United States—or the use of domestic inputs—to qualify for support (or have higher support levels granted under such conditions). Both the EU's Temporary Crisis and Transition Framework (TCTF) and its Net-Zero Industry Act can be seen as a response to the IRA initiative.

The EU framework for green support has been criticized on several grounds, highlighting various shortcomings. The system is often regarded as overly complex and fragmented, as

[18] The project also received state aid financed partly through EU's Recovery and Resilience Facility (RRF) (European Commission, 2024b). The H2 Green Steel project (renamed Stegra in 2024) is evaluated by Johansson and Kriström (2026).

multiple overlapping and sometimes contradictory guidelines apply, forcing firms to navigate several parallel funding schemes with differing principles and conditions. The case-by-case negotiation-based approach lacks clear *ex ante* criteria. This creates incentives for rent-seeking behavior, as firms may strategically exploit the "funding gap" logic to secure subsidies for cost-inefficient projects. Moreover, the framework tends to favor large, well-established incumbents with the resources, networks, and administrative capacity to manage the process, thereby disadvantaging smaller and more dynamic entrants (Dings & Sol, 2025).[19]

The U.S. system offers a more streamlined and output-based model, with automatic tax credits that can be claimed *ex post* through the tax system. This simplicity may reduce administrative burdens and accelerate deployment, but the IRA system entails its own problems. Critics have highlighted the escalating fiscal costs where the uncapped design makes total fiscal costs highly uncertain. Moreover, the reliance on subsidies rather than carbon pricing has raised concerns regarding cost-effectiveness. The support system is further criticized for its complexity and lack of neutrality, due to the inclusion of arbitrary clauses concerning location, labor requirements, and input use. It may also risk trade distortions and tensions with international partners (see, e.g., critique from the Tax Foundation, 2025). In this sense, the EU framework may lack efficiency and transparency, while the U.S. model achieves speed and scalability at the expense of fiscal predictability, neutrality, and international coherence.

While the comparative analysis primarily contrasts the European Union and the United States, national initiatives in the UK, Germany, and Sweden highlight further diversity. The UK's Ten Point Plan and the creation of Great British Energy (GBE) exemplify a centralized approach relying on a state-owned enterprise to co-develop projects and crowd in private investment. Germany's *Energiewende* and the Climate and Transformation Fund (KTF) demonstrate long-term institutionalization of climate goals, but also fiscal and constitutional constraints, which have led to creative financing mechanisms. Sweden represents a smaller open economy combining EU-level funding with domestic grant programs like *Klimatklivet* and *Industriklivet*. Together, these cases show that while all three countries pursue ambitious targets and the latter two also align with EU goals, their strategies diverge in institutional design.

[19] For further critique of and problems with the prevailing European system, see European Court of Auditors (2024).

Conclusion

Green Deals represent a profound shift in economic governance, blending industrial and environmental policy in ways that challenge traditional economic doctrines. The EU approach is expansive but fragmented, relying on overlapping instruments and complex state aid rules, while the U.S. Inflation Reduction Act prioritizes scalability and simplicity through uncapped tax credits, though at the cost of fiscal unpredictability and non-neutrality. National cases such as the UK, Germany, and Sweden further illustrate how institutional contexts shape the design and delivery of support. Despite their differences, these policies share a common reliance on large-scale public intervention to catalyze private investment to achieve the green transition.

Yet critical questions remain regarding efficiency, fiscal sustainability, and international trade effects. Further academic scrutiny is essential to understand both the promise and the risks of mission-oriented industrial policy in addressing climate change.

Appendix: The EU Support System

Direct public funding—National level

According to the EU treaties, the member states cannot unconditionally support corporations and sectors in the economy as that would risk distorting competition between companies in different countries of the Union. Therefore, there has been a general prohibition of state aid (with some exceptions). However, due to the COVID-19 crisis and the Ukraine war this policy has been softened. By introducing temporary "crisis frameworks", the EU allows its member states to temporarily deviate from the principle of banning state aid. In March 2023, the framework was amended and the exception was prolonged, now allowing public funding to support the national transition to climate-neutral economies under the Temporary Crisis and Transition Framework, TCTF.[20] According to TCTF, state aid can always be granted to all renewable technologies, green hydrogen, and biofuel storage projects (TEPSA, 2023). In July 2025, TCTF was replaced by the Clean Industrial Deal State Aid Framework (CISAF), simplifying and prolonging the possibility to give state aid focusing on green energy, industrial decarbonization, and clean-tech manufacturing (European Commission, 2025e).[21]

Between 2012 and 2022, state aid support for green endeavors amounting to EUR 630 billion was granted. These aid schemes were five times larger than aid targeted towards underdeveloped regions (the second most used objective referred to when circumventing the aid restriction), between 2017 and 2022 (European Commission, 2025f).

Direct public funding—EU level

One problem with national state aid is its skewed distribution between countries. There is a varying capacity and willingness to grant support to green industries across the member states. A dilemma for the EU is that large and rich countries—notably Germany and France—have greater interest and opportunities to support their industries. Providing support from the EU level to avoid the distortions and fragmentation of the Single Market that a highly skewed national funding can create is seen as important. Hence, it is argued that scaling up industrial

[20] However, already in January 2022, the EU introduced new guidelines on state aid for climate, environmental protection and energy (CEEAG), updating earlier rules from 2014, to assess when national aid for environmental and climate protection should be allowed in order to create a flexible framework to support the Green Deal objectives (European Commission, 2022). Hence, there exist overlapping parallel EU state aid rules, which complicates the support system.

[21] To speed up investment in line with the Green Deal industrial plan, the EU has also amended the General Block Exemption Regulation (GBER)—after 2023 denoted Green Deal General Block Exemption Regulation—which makes it possible for member states to provide certain types of— particularly climate- and energy-related—state aid without requiring prior approval from the European Commission.

support at the EU level while expanding its scope is required to facilitate the green transition across the Union and to create a level playing field for all companies acting inside EU borders.

To support the green transition at the union level, 30% of EU's long term-budget (Multiannual Financial Framework, MFF) is therefore earmarked to support different climate- and environment-related objectives by providing the European Green Deal Investment Plan with funds. In practice, this means that the EU is supposed to spend more than EUR 500 billion between 2021 and 2027, taken directly from the EU budget for this issue. The EU funding is expected to be complemented with more than EUR 100 billion by the member states (Pons & Madec, 2024).

Recovery and Resilience Facility

As a response to the covid-19 pandemic, the EU did not only relax the state aid rules, they also launched the Recovery and Resilience Facility (RRF) as an instrument to support its member states. Based on the member states' national recovery and resilience plans—which outlined proposed reforms and investment projects requiring support—the EU was able to provide funding to its member states through the facility. Together with the changing state aid rules, the RRF's objective has been widened, and funds are now also used to facilitate the green transition among its member states. At the time of writing, national recovery plans must allocate at least 37% of their recovery expenditure to climate-related investments (Pisani-Ferry & Tagliapietra, 2024; Pons & Madec, 2024).[22]

To build up the RRF, the EU raises funds by borrowing on the capital market (e.g., by issuing so-called green bonds). This is the first major instance of joint EU borrowing to finance member state spending. In the next step, these funds are made available by request to member states through grants and loans. However, payouts to member states are performance-based, and EU disburses the amount it has raised on the capital markets in arrears when specific pre-defined targets in line with the national recovery plans are met. The part of the funds that is used to give grants will in the final step be returned to the capital market over the EU budget (e.g., when the green bonds expire). RRF consists of EUR 650 billion available for investments, of which more than EUR 350 billion is earmarked as grants (European Commission, 2025g). Member states are also allowed to use RRF funds to finance IPCEI.

[22] In addition, a minimum of 20% must be devoted to digital investments.

NextGenerationEU

Besides funds allocated directly from the EU budget, the Green Deal Investment plan is complemented by loans and grants from an instrument called NextGenerationEU presented by the Commission in May 2020. The bulk of the NextGenerationEU is financed through the RRF as described above. In the same way as RRF, it was initially a temporary recovery instrument to dampen the economic downturn that member states were facing due to the Covid-19 crisis but is now also a way to support member states' green transition. Altogether NextGenerationEU decides over EUR 750 billion that should be spent before the end of 2026 when the instrument ends (European Commission, 2025h).

RePowerEU

In order to phase out the dependence on Russian fossil fuel, the RePowerEU plan was launched in May 2022. The goal was to speed up the green transition and promote massive investment in renewable energy. REPowerEU is used to promote the expansion of renewable energy sources such as solar, wind, and hydrogen, with the goal of substantially increasing the use of solar photovoltaic power and renewable hydrogen. The main financing source is the above-described Recovery and Resilience Facility (RRF). The EU has mobilized EUR 300 billion for these purposes (European Commission, 2025i). The European Investment Bank Group will also support the objectives of RePowerEU with additional loans and equity (European Commission, 2023b).

InvestEU

InvestEU is a program launched in 2021, with the general purpose of stimulating private investments in the Union by bringing together a multitude of earlier EU financial instruments. Within the program public funds and guarantees are used to reduce the cost and risks of private investments in prioritized areas, including private initiatives in line with the Green Deal objective. At least 30% of the InvestEU program must support climate- and environment-related projects.

The program will provide EU budget guarantees to allow the European Investment Bank (EIB) or other implementing partners to invest in (and lend to) more high-risk green projects. EU guarantees of EUR 26.2 billion are supposed to spur private investment and it is claimed that it could mobilize additional private investment of at least EUR 370 billion by 2027. Funding comes partly from NextGenerationEU (Pons & Madec, 2024; European Commission, 2025j).

Innovation Fund

To further support the decarbonization of European industry and bringing cutting-edge technologies to the market, the EU has set up a specific innovation fund. It is said to be "the world's largest funding programmes for the deployment of net-zero and innovative technologies." The fund is financed through the EU Emission Trading System (EU-ETS). How much money that will be released through the fund will depend on the carbon prize, but it is estimated that the fund will raise approximately EUR 40 billion between 2020 and 2030. The fund can support up to 60% (or, in special cases, even 100%) of the capital and operational costs (minus revenues) during the first ten years. Innovation Fund projects are required to share knowledge to spur spillover effects to support other companies, sectors, projects, or future applicants. In early 2025, some 200 projects had been awarded support (European Commission, 2025k).

EIB group

The EIB group, i.e., the European Investment Bank (EIB) and the European Investment Fund (EIF), is an integral part when it comes to the Green Deal by supporting different initiatives, plans, or programs, such as InvestEU. Financing the green transition is nowadays the bank's first priority (Pisani-Ferry & Tagliapietra, 2024). EIB is supposed to mobilize investments under the EU instruments (as described above) and through the EU budget amounting to around EUR 250 billion. In addition, 50% of their total lending should be directed towards activities related to climate change. They are on track to support green investment to a total value of EUR 1 trillion until 2030 (Pons & Madec, 2024).

Miscellaneous

In order to alleviate the negative effects of the green transition that may disproportionately hit certain groups or regions, the EU has created a Social Climate Fund and a Just Transition Fund to support vulnerable groups (Social Climate Fund) or regions (Just Transition Fund) with resources and different forms of financial support. A so-called Just Transition Mechanism is mandated to support underprivileged regions with EUR 55 billion between 2021 and 2027, partly financed by the Just Transition Fund (Pons & Madec, 2024; European Commission, 2025l).

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