Public investments in COVID-19 green recovery packages: A comparative analysis of scale, scope, and implementation in France, Germany, and the United Kingdom

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Abstract

This article analyses the size, sectoral allocation, and implementation choices of green recovery spending plans in France, Germany, and the UK, which differ markedly. France spends most, both in absolute and GDP-relative terms, followed by Germany. Total UK spending is 43% less than France. The UK and France mostly support existing sectors (buildings, railways), while Germany focuses 57.8% of its funding on new technologies (electric vehicles, hydrogen). We explain these differences by identifying varying emphases on multiple motivations, including climate mitigation, jobs, GDP growth, productivity, exports, global competitiveness, regional support, social fairness, party politics, and electoral ambitions. We relate these different motivations to context conditions such as varying socio-economic effects of the COVID-crisis, pre-existing concerns (e.g., high unemployment, social and regional inequalities), the economic importance of particular sectors, and pre-existing climate policy plans. Instead of interpreting the crisis as providing a clean slate for policymakers to commit to green recoveries, we show that policy responses are powerfully shaped by pre-existing contexts, plans and developments.

1. Introduction

The COVID-19 pandemic is not only a health crisis but also a socio-economic crisis, which through various forms of lock-down has shrunk the global economy by 3.5% in 2020 (IMF, 2021) and increased unemployment. In response, governments launched unprecedented financial stimulus programmes, amounting to USD 13 trillion globally by December 2020 (Vivid Economics and Finance for Biodiversity Initiative, 2020). These stimulus programmes aimed to provide immediate, short-term support to mitigate bankruptcies and job losses and to stimulate medium- and longer-term economic recoveries.

Because the COVID-pandemic struck at a time of heightened concern about environmental sustainability and climate change, many policy organizations and academics have called upon governments to use substantial parts of the stimulus packages for a 'green recovery' that would stimulate the economy and drive low-carbon transitions (IMF, 2020; Rosenbloom and Markard, 2020; Steffen et al., 2020). This topic has sparked a rapidly growing literature within which we distinguish three groups of contributions.

A prescriptive group aims to offer advice for potential funding proposals by identifying green innovations with high economic multiplier effects (for jobs and GDP growth) such as renewable electricity (wind, solar-PV), batteries, hydrogen, electricity grids, building insulation, heating technologies, electric vehicles and recharging infrastructure, cycling infrastructure, low-carbon industrial options, and natural capital (Hepburn et al., 2020; IEA and IMF, 2020; Kanda and Kivimaa, 2020; OECD, 2020).

A more critical, reflexive group of (political science) scholars has suggested that the socio-economic crisis may lead to the roll-back of environmental regulations and to status quo support for carbon-intensive sectors (e.g., airlines, fossil fuel industries, energy-intensive industries) rather than investments in a green recovery (Gosens and Jotzo, 2020; Hanna et al., 2020; Victor, 2020). Their arguments build on historical experiences with the 2008/9 financial-economic crisis. This crisis gave rise to optimistic pleas for a Green New Deal but ultimately disappointed both in the relative amount of green investment, which, broadly defined, was USD 463 billion or 15% of the global USD 3 trillion stimulus (Barbier, 2010; Tienhaara, 2018)[1], and in the climate mitigation effects, as greenhouse gas (GHG) emissions rebounded strongly after the immediate shock (Jaeger et al., 2020).

A third group of contributions has provided empirical descriptions of green stimulus packages by different countries, focusing mostly on total spending amounts and some sectoral disaggregation, but without providing much explanation. For example, the Energy Policy Tracker provides real-time data on public finance for energy around the world (https://www.energypolicytracker.org/). And Vivid Economics and the Finance for Biodiversity Initiative have produced several editions of their *Greenness of Stimulus Index*, which analyse how green the stimulus packages of different countries are. The December 2020 edition shows that global green recovery allocations were USD 567 billion, which is larger in absolute terms than the post-financial crisis Green Deal, but smaller in relative terms, as it amounts to only 4% of the total global stimulus in 2020. This edition also identifies a handful of countries as leaders in green recovery spending, namely Germany, France, United Kingdom, South Korea, and the European Union (Vivid Economics and Finance for Biodiversity Initiative, 2020).[2]

[1] A narrower focus on clean energy identified investments of USD 177 billion or 6% of the total stimulus (WEF, 2010).

[2] The majority (EUR 672.5 billion) of the European Union's EUR 750 billion Next Generation EU recovery package will be spent through Member States who can apply for recovery funding by submitting national investment plans that meet certain criteria, which include allocating at least 37% of funding to green initiatives.

None of these three groups of contributions provides much analysis or explanation of actual green recovery plans, perhaps because these are still relatively recent and unfolding. Addressing this gap, our article aims to contribute to this emerging literature by providing an in-depth analysis of actual green recovery packages in three leading countries: Germany, France, and the UK. Although these countries have similar GDP, population size, and climate mitigation commitments (Table 1), their green recovery packages varied significantly. Focusing on the *scale* of total green recovery funding, the *scope* in terms of sectoral and technological allocation, and more detailed *implementation* policies, we aim to explain these differences by analysing the strategic and political motivations and contexts that guided the choices in each country.

Country	**GDP in 2019**	**Population 2020**	**Net-zero by 2050**
France	EUR2,426 bn	67.4 million	Target embedded in law in June 2019
Germany	EUR3,449 bn	83.8 million	Adopted as goal in 2016
United Kingdom	EUR2,527 bn (GPB2,218 bn)	67.9 million	Target embedded in law in June 2019

Table 1: GDP, population size and climate mitigation commitments in France, Germany, and the UK

Our analysis diverges from contributions in the first and third group, which often assume that the crisis has disrupted the status quo and therefore provides policymakers with a 'clean slate' to commit to green recoveries. This way of thinking finds some theoretical support in the 'critical juncture' approach (Capoccia and Kelemen, 2007; Rosenbloom et al., 2018) and punctuated equilibrium theory in political science (Baumgartner et al., 2009; Jones and Baumgartner, 2012), which both suggest that external shocks can weaken the lock-in mechanisms that constrain normal incremental policymaking and thus provide policymakers with more agency to decide on major policy changes that alter development trajectories.

While acknowledging that exogenous shocks can generate 'windows of opportunity' for transitional change and agency (Geels et al., 2017), we mobilise other theoretical insights that also acknowledge the role of constraining socio-economic and political contexts in shaping policy choices. Recent contributions to the critical juncture debate, for instance, suggest that agentic responses to shocks are not entirely free but shaped by "productive conditions", such as the effects produced by shocks that need addressing, and by "critical antecedents" (Soifer, 2012: 1575-1576) which are the factors, conditions, concerns, or developments that *precede* a critical juncture but causally shape policy responses (Rinscheid et al., 2020). For COVID-19 related green recoveries, productive conditions include the effects of lockdowns on unemployment, GDP, or exports, while critical antecedents include pre-existing climate mitigation plans, pre-existing concerns (e.g., about high unemployment in France or stagnating exports in Germany) or pre-existing technological initiatives.

Building on the political science literatures on package deals and issue linkage (Davis, 2004; Huelshoff, 1994; Kardasheva, 2013), which both suggest that large-scale policy reforms or plans address the concerns of multiple constituencies to broaden support, we further expect that green recovery packages are likely to have multiple motivations. The literature on policymaking in crisis conditions additionally suggests that multiple modes of decision-making tend to be in play because major crises are characterised by urgency, complexity, and uncertainty (Allison, 1971; Caball and Malekpour, 2019; Wenzelburger et al., 2019). One mode is rational decision-making, which aims to analyse the macro-economic effects of the crisis and identify the most (cost-)effective responses. For green recovery packages we therefore expect that countries with high unemployment effects will allocate more funding to labour-intensive sectors, while export-oriented countries will spend

more on industry modernisation. We also expect that governments are likely to spend more on those green technologies or sectors where they have larger economic interests.

Since time pressures and uncertain information in crisis situations complicate rational decision-making, another decision-making mode is to draw on existing routines, heuristics, repertoires, and plans. Rather than making new plans from scratch, it is easier and quicker to implement or expand pre-existing plans or initiatives. This aligns with Kingdon's (1984) view that crises open up windows of opportunity that allow policy entrepreneurs to push their 'pet proposals'. For green recovery spending, we therefore expect that countries are likely to allocate more resources to sectors with pre-existing climate strategies or on-the-ground initiatives.

The third decision-making mode is political (Allison, 1971; Bermeo and Pontusson, 2013), which refers to role of power struggles, coalition building, and party-political interests. We therefore expect that green recovery packages are likely to become aligned with wider political motivations and salient issues that help to broaden support or allow senior politicians to advance party-political and electoral interests.

Guided by these considerations, our investigation will analyse the choices and multiple motivations in the 2020 green recovery spending plans of German, French and UK governments. Section 2 discusses our research design and data sources. Section 3 analyses the scale of total green recovery funding in the three countries and high-level strategic and political motivations. Section 4 analyses the scope of how funding is allocated to different sectors and technologies and the intended spending timeframe. It also explains salient differences between the countries using the high-level strategic and political motivations identified in section 2. This analysis focuses on hydrogen, electric vehicles, buildings retrofit, and railways which account for the bulk of the allocated funding. Section 5 analyses more detailed implementation and delivery policies, which also show marked differences that we aim to understand. Section 6 discusses the results and section 7 draws conclusions.

2. Research design

Our research design is tailored to analyse the scale, scope, and implementation of the 2020 green recovery packages in France, Germany, and the United Kingdom. To investigate the *scale* of funding intentions, we analysed the countries' recovery packages, and the green plans within them, using primary data from government reports, budgets, and communications. We further embedded the recovery packages in country contexts to identify the government's underpinning motivations and rationales for the scale of the recovery packages.

To understand macroeconomic contexts and motivations, we collected longitudinal country-specific data for unemployment, exports, and GDP growth from Eurostat (https://ec.europa.eu/eurostat). These data show the differential effects of COVID-19 across the three countries and help contextualise pre-existing concerns about economic strengths and weaknesses. We also used Eurostat for data about the economic size and importance of particular industries (in terms of value-added, exports, and jobs) and the relative contribution of particular sectors to overall GHG emissions. This helped us to understand country differences in funding allocations to particular sectors and technologies.

We also analysed the climate mitigation plans of the three countries to collect information about their pre-existing commitments and sector-specific policies and strategies. To understand political motivations, which the official government documents do not explicitly mention, we collected information from published literature from think tanks, consultancies, research institutes, and news media coverage. These sources provide in-depth and up-to-date understandings of political considerations in their countries. However, we

recognise they may have particular orientations that can affect their reporting and interpretation. To mitigate this limitation, we factchecked claims and statements with secondary sources.

To understand the *scope* of the funding plans, we analysed the allocation structure of green recovery spending. We identified the sectors receiving support and focused on a sub-set of four sectors that received most support across the countries, namely hydrogen, electric vehicles, building retrofits, and railway infrastructure. We analysed, collected, and coded data from each country's recovery package to identify individual green recovery measures. We specified the target sector, budget allocated, and timeframe for budget spending. To interpret these data, we drew on the recovery motivations identified in the scale investigation and considered how these relate to sectoral funding allocations.

Lastly, to investigate *implementation* we analysed each country's detailed measures for delivering green recovery in the four main sectors. To that end, we collected information from the government recovery plans and budgets as well as literature from think tanks and news media, which was valuable considering the recent nature of COVID-19 green recovery policies. Where applicable we highlight when country recovery motivations are visible in specific implementation choices in each country.

Across these three analytical layers (scale, scope, implementation), we draw on primary data on country budgets and motivations from the official recovery plans, which varied in length and detail between the countries. For instance, while German and French plans provide relatively clear and disaggregated information about spending amounts and timeframes, the UK plans were often less precise, particularly about spending timeframes. Since the UK plans often refer to 2030, in our analysis we have assumed that spending would be spread between 2020 and 2030, unless otherwise stated. While we recognise that governments may inflate their green recovery budgets for public relations reasons, through relabelling and including pre-existing spending commitments into new plans, it is beyond the paper's scope to address this.[3]

3. Scale: Total amounts of economic and green recovery spending

Looking at scale, Table 2 shows how much funding the three countries dedicated to green recovery spending. France allocated EUR 30.4 billion, Germany EUR 27.5 billion, and the UK GBP 15.45 billion (= EUR 17.3 billion).[4] French and German green recovery plans were part of broader economic recovery plans, respectively the EUR 100 billion *Relaunch France* plan and the EUR 130 billion *Economic Crisis Management Package and Future package*. The UK did not present a unified economic recovery package. French and German green recovery spending were respectively 30.4% and 21.2% of their broader economic recovery plans. In relation to their 2019 GDP, green recovery spending amounted to 1.25% in France, 0.8% in Germany, and 0.69% in the UK (Table 2). To understand these country differences, we will further analyse their economic recovery and green recovery plans, focusing on the strategic rationales and considerations.

[3] For the UK, for instance, it has been reported that only GBP 4 billion of the GBP 12 billion investment in *The Ten Point Plan for a Green Industrial Revolution*, announced in November 2020, is new money (Walker and Elgot Jessica, 2020).

[4] The UK number includes both GPB 5.24 billion of green measures from the *Plan for Jobs* and GPB 10.21 billion from *The Ten Point Plan*. Although *The Ten Point Plan* is often said to amount to GPB 12 billion of green spending, adding up the money allocated to specific technologies and sectors amounts to GPB 10.21 billion, which is what we have decided to use.

	Green recovery spending	Economic recovery packages	Green as % of economic recovery	Green as % of GDP
France	EUR30.4 bn	EUR100 bn	30%	1.25%
Germany	EUR27.5 bn	EUR130 bn	21.2%	0.80%
UK	GPB15.45 bn (= EUR17.3 bn)	No unified recovery package	Unclear	0.69%

Table 2: COVID-related government spending on green recovery, economic recovery, and total financial support (constructed using (Eurostat, 2020c; French Government, 2020b; SPD, 2020; UK Government, 2020b, 2020c))

3.1. France

France's EUR 100 billion economic recovery plan, released in September 2020, has job creation and sustainability as the two main goals: "The recovery plan is a forward-looking investment plan with two key objectives: speeding up the greening of the economy and supporting job creation" (French Government, 2020a: 5).

The emphasis on sustainability and climate change relates to the fact that France already had substantial commitments, policies and institutions in place for these challenges before the COVID-pandemic. In 2015, France adopted the *Energy Transition Law* which articulated energy and climate mitigation targets for transport, housing, and renewable energy. In 2017, it created a Ministry of Ecological and Solidarity Transition, which was renamed to Ministry of the Ecological Transition in 2020. And in July 2019, France announced legislation to reach net-zero GHG emissions by 2050. These pre-existing plans and commitments help explain why sustainability considerations feature prominently in the French recovery strategy.

The plan's emphasis on job creation relates to the fact that France has experienced persistently high unemployment since the 2008 financial crisis, more so than Germany and the UK (Figure 1). Unemployment started decreasing somewhat since the mid-2010s, but rapidly increased again due to the pandemic, which pushed the issue up the policy agenda, making it a core issue for the French recovery plan.

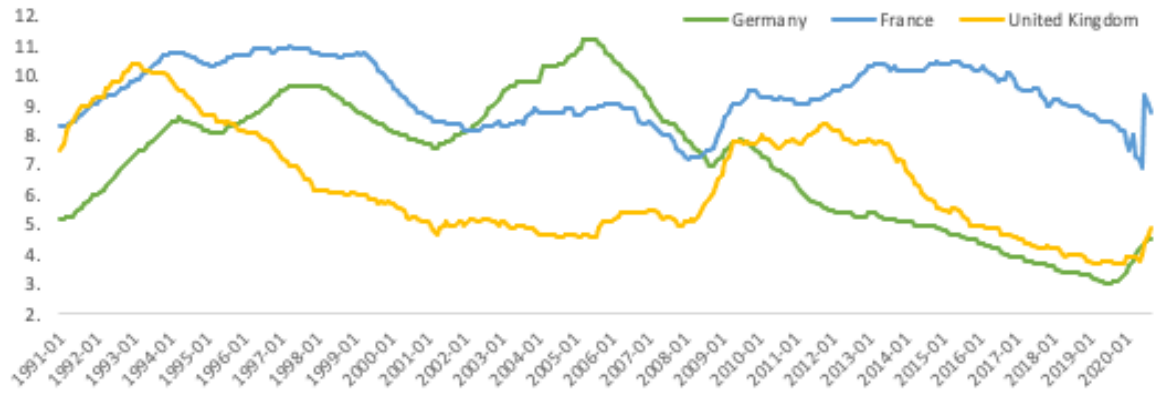

Figure 1: Unemployment rate, 1990-2020 in Germany, France, and the UK as % of the labour force (constructed using data from (Eurostat, 2021k)*)*

Besides addressing sustainability and job creation, the three pillars of the recovery package indicate that regional support, social justice/fairness, and industrial productivity and competitiveness are also important strategic considerations. These three pillars are: green transition (EUR 30 billion), competitiveness and resilience of the economy (EUR 34 billion), and skills, social, and territorial cohesion (EUR 36 billion) (French Government, 2020a).

The emphasis on regional support relates to the fact that regional disparities, such as the gap in GDP per capita between the capital region (Île-de-France) and the rest of the country have increased since 2000 (OECD, 2019). This has fed into a wider sense of unfairness, frustration, and anger, which underpinned the 2018 yellow vest protests. These protests were triggered by a proposed carbon tax that would raise fuel prices but were an expression of deeper resentments. To avoid new inequality-motivated protests, *social issues* are therefore also a prominent consideration in the recovery plans.

The economic (and green) recovery plans also have industrial productivity and economic growth as a longer-term strategic goal: "The recovery plan will contribute to France's long term economic development and to strengthening its industrial resilience and independence. It includes measures to support the green and digital transitions, as well as the structural reforms planned by the government to further improve the competitiveness, attractiveness and productivity of the French economy" (French Government, 2020a: 5). This focus relates to the fact that France's economy has long been under-performing other major European economies and was particularly hard hit by the COVID-related lockdowns, which led to an 8.1% decrease in GDP in 2020 (Figure 2). The French government therefore hopes that the EUR 100 billion investment plan (which at 4% of national GDP was the largest in Europe relative to the scale of its economy) would "restore the 2019 level of GDP by 2022" (French Government, 2020a: 5). This attempt to nurture and stimulate strategic sectors and industries resonates with the French economic tradition of state-planning, which between 1946 and 2006 was done by the powerful 'Commissariat du Plan'.

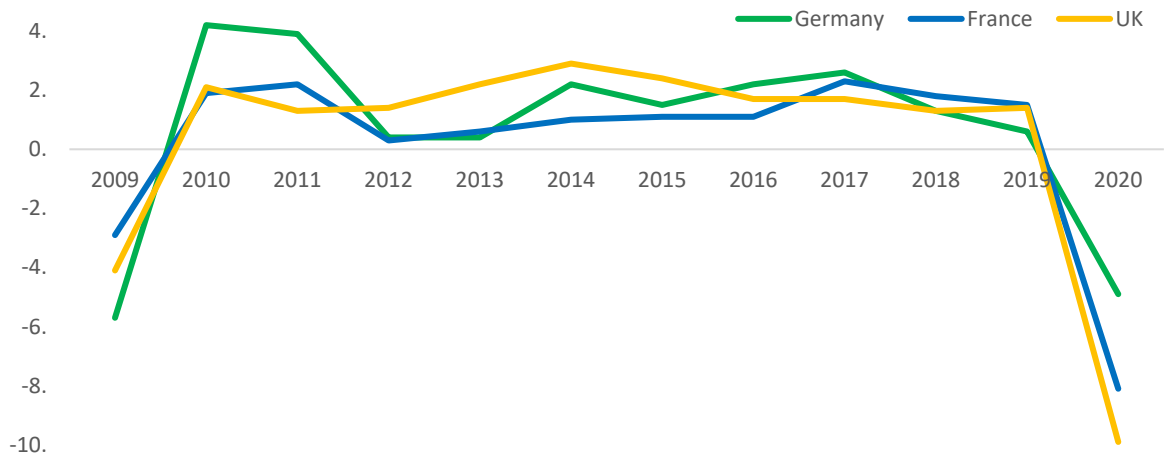

Figure 2: Annual real GDP growth rate in Germany, France and the UK, 2009-2020 (constructed using data from (Eurostat, 2021j)*)*

The Institute of International & European Affairs, an Irish think tank, suggest that Macron's political ambition in the upcoming 2022 presidential election formed another motivation behind France's economic and green recovery plans (Quain, 2020). To improve his approval ratings, they suggest that Macron is using the recovery plans to rebrand himself as a green and visionary transformer who knows how to turn the crisis into an opportunity and prepare France for 2030. This rebranding strategy is inspired by the Green party's success in the June 2020 municipal elections, which suggests that green issues are popular with the electorate (Quain, 2020). France's plans to spend the bulk of the recovery money between 2020 and 2022 (French Government, 2020a) also resonate with Macron's hopes that growth and jobs rebound before the 2022 election.

Another strategic consideration is to align French recovery spending with the European priorities of the EUR 672.5 billion EU Recovery and Resilience Facility (RRF),

which EU Member States can access by submitting recovery and resilience plans that include a minimum of 37% of expenditure on climate investments. Because France hopes to fund 40% of its economic recovery plans through EU contributions, its green recovery spending is substantial and aligned with several RRF flagship areas including clean technologies and renewables (including hydrogen), energy efficiency of buildings, sustainable transport and electric vehicle charging stations (European Commission, 2021).

3.2. Germany

Germany's EUR 130 billion economic recovery plan, released in June 2020, has two main pillars, which both require the allocated money to be spent in 2020 and 2021.[5] The first pillar is a short-term economic and crisis management plan (EUR 77 billion), which aims to alleviate immediate socio-economic problems by "boosting the economy, preserve jobs; cushioning economic and social hardships; strengthening federal states and municipalities; and supporting young people and families" (SPD, 2020: 1). An important instrument, aimed at stimulating short-term national consumption, was a six-month 3% VAT reduction (EUR 20 billion).

The second, more forward-looking, pillar is the *Package for the Future* (EUR 50 billion), which aims to "support Germany's role as a high-tech exporter; strengthen future investments in green technologies; and strengthen the health system and improve protection against pandemics." This package includes the EUR 27.5 billion green recovery package, which represents a significant level of investment that signals the country's support for a low-carbon transition, as indicated by pre-existing plans.

Germany introduced an electricity transition strategy in 2011 and adopted the *Climate Action Plan 2050* in 2016, which strives for climate neutrality by 2050 and aims to reduce GHG emissions by 55% by 2030 (compared to 1990). The 2019 *Climate Action Law* disaggregates the overall goal into sectoral GHG reduction targets for electricity, buildings, transport, industry, agriculture, waste, and other.

Despite these pre-existing climate commitments and policies, the German green recovery package was more motivated by export and economic growth considerations than by climate mitigation. This is visible, for instance, in the green recovery focus on export-oriented sectors (such as car manufacturing, chemicals, and steel) and new technologies such as electric vehicles and hydrogen production and use (as will be further discussed below). Other climate-relevant sectors like buildings and agriculture have received much less attention.

The Germany-based international consultancy *Changing Transport* noted that: "The primary focus of Germany's stimulus programme is clearly responding to the economic impacts of the crisis as well as setting the framework for a recovery. It is not a climate or environmental action plan. Avoidance or reducing of external environmental effects were not the driver of the measures" (Mahler, 2020). A recent Green Recovery Tracker report also concluded that: "Germany's measures are largely not linked to any concrete long-term targets or climate conditions" (Wuppertal Institute and E3G, 2021: 2).

The *Package for the Future* was not merely a response to the socio-economic crisis but also an ambitious attempt to "lead Germany back onto a sustainable growth path that secures jobs and prosperity. This not only requires a reaction to the effects of the crisis, but also much more of an *actively designed innovative modernization push* and the resolute elimination of existing deficits" (SPD, 2020: 1; emphasis added). The exports of manufactured goods contribute very substantially to Germany's GDP (38% in 2019), with motor vehicles, machinery, and chemicals forming the top three export products. It is

[5] It also has a relatively small third pillar on international collaboration (EUR 3 Billion).

therefore not surprising that the modernization of export-oriented sectors is a central component of Germany's economic and green recovery plans.

The modernization efforts towards a new growth path were particularly motivated by concerns amongst executives and policymakers about the country's struggles against foreign competition. While German exports benefitted strongly from globalization in the 1990s and early 2000s (Figure 3), they stagnated after 2012, as emerging economies offered stronger competition and accounted for increasing shares of global exports, leading Germany and China to swap second and third place in the top-20 of world traders of goods and services between 2008 and 2018 (World Trade Organization, 2019: 11).

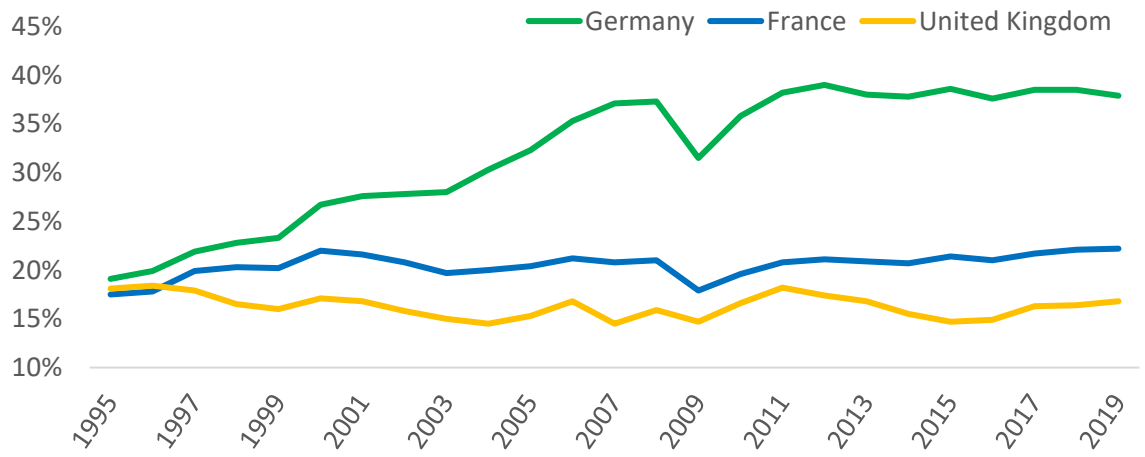

Figure 3: Exports as percentage of GDP in Germany, France and the UK, 1995-2019 (constructed using data from (Eurostat, 2021b)*)*

In 2019, the Minister for Economic Affairs and Energy (Peter Altmaier) therefore developed a new industrial strategy, *Made in Germany: Industriestrategie 2030*, which envisaged a stronger government role in guiding industrial investments in new technologies such as artificial intelligence, batteries, and clean energy (Jennen and Delfs, 2020). Although the strategy was heavily criticized and rejected in 2019, the COVID-crisis created a window of opportunity for the revival of some of its core ideas, including a stronger role for government. The economic recovery package was not only larger than most observers had expected, signalling transformative ambitions, but also "gave officials in Berlin new powers to intervene in the economy: they will be picking winners and losers, seeding new industries and grooming national champions. Buying stakes in companies is no longer taboo, and the touchstone balanced-budget policy has been jettisoned to unleash the full power of the German balance sheet" (Jennen and Delfs, 2020).

The specific industries and technologies that were selected (which will be further discussed below) also resonate with European initiatives and priorities including electric vehicles, low-carbon hydrogen, and green steel (Gagnebin, 2020). This suggests that alignment with the European project and cooperation with European partners (especially France) were other strategic considerations for the German economic and green recovery plans. Additionally, German policymakers hope that this alignment enables it to receive EUR 29.3 billion from the EU Recovery and Resilience Facility, which it requested in December 2020.

3.3. United Kingdom

The UK did not present a unified long-term recovery package like those in Germany and France. Long-term recovery measures were, however, included in the country's GBP 30

billion *Plan for Jobs*, released in July 2020, which focused most support (GPB 17.7 billion) on *sustaining* employment through measures such as a job retention bonus, reduced VAT rate for the hospitality and accommodation sector, and placements and apprenticeship schemes. It also allocated GPB 12.5 billion to creating *new* jobs with actions to get the property market moving again (through a temporary stamp duty holiday), to increase and bring forward infrastructure investment, and to make homes greener and warmer. Green recovery spending in the *Plan for Jobs*, which included the Green Homes Grant, public sector and social housing decarbonisation, and other measures, amounted to GBP 5.24 billion. The Plan for Jobs paid relatively little attention, however, to long-term economic growth, productivity, exports, or industrial modernization, which is surprising considering the country's 9.9% GDP decrease, which was larger than the economic hit in Germany and France (Figure 2).

The *Ten Point Plan for a Green Industrial Revolution*, released in November 2020, introduced measures to support a green recovery. Although touted as providing GPB 12 billion of funding, the plan lacks implementation clarity because the stated commitments to specific technologies and sectors amount to GPB10.21 billion. Some spending timeframes are also unclear. The allocated funding (even with the GPB 5.24 billion from the Jobs Plan) is substantially less than that of Germany and France, and spread across technologies and sectors, which may be due to the multiple strategic objectives in the *Ten Point Plan* (TPP).

One objective is to reduce GHG emissions. This objective aligns with pre-existing commitments such as the 2008 Climate Change Act, which committed the UK to reducing GHG emissions by 80% by 2050, and secondary legislation in June 2019 that enshrined the net-zero target by 2050 in law. Various TPP measures also align with more detailed pre-existing climate policy plans such as the 2009 *UK Low Carbon Transition Plan*, the 2011 *Carbon Plan*, the 2017 *Clean Growth Strategy*, and the 2020 *Energy White Paper*, which were developed to reach the GHG reduction targets.

As host of the 2021 Conference of the Parties (COP-26) meeting in Glasgow, the UK also uses the TPP measures to demonstrate global climate change leadership, which may improve the meeting's chance of success. This reputational motive aims to provide some evidence for the post-Brexit slogan of 'Global Britain'. With regard to this objective, the TPP has been criticized, however, for being less ambitious or 'world-leading' than Germany and France, which both provide more green recovery funding.

Another TPP objective is to create jobs, with the plan claiming it will generate 250,000 green jobs by 2030. It is hoped that these jobs will "reinvigorate our industrial heartlands" (UK Government, 2020c: 6), which have languished in recent decades as UK companies struggled to compete internationally. This industrial decline, and the country's broader shift towards a service economy, has generated regional inequalities, which are amongst the worst in OECD countries (McCann, 2020). The TPP therefore also hopes that investments in new technologies and industries may 'level up' the country and revitalize disadvantaged regions, which thus forms an additional objective.

This 'levelling up' ambition also has party-political motivations, because the Conservative Party hopes to maintain the new seats it won in disadvantaged regions in the 2019 elections. Another party-political motivation is that TPP spending enables the Conservative Party to meet its election pledge to increase funding for building retrofits.

Another TPP motivation is to stimulate economic growth and exports by "making the UK a global leader in green technologies" (UK Government, 2020c: 4) and "pioneering new British industries" (UK Government, 2020c: 5). It remains unclear, however, how these ambitions will be achieved, although references to the UK's science base and the "powers of invention" (UK Government, 2020c: 3) suggest an implicit use of the linear model, where R&D is presumed to drive innovation and economic growth (Godin, 2006). The TPP also assumes that infrastructure investments (in carbon-capture-and-storage, hydrogen, railways,

cycle lanes, electric charging, and offshore power grids) will drive economic growth. This expectation resonates with earlier policy plans such as the 2017 *Industrial Strategy* and the 2020 *National Infrastructure Strategy*. The UK's 2021 *Plan for Growth* also has high hopes that infrastructure investment (in broadband, roads, rail, and cities) will "stimulate short-term economic activity and drive long-term productivity improvements" (UK Government, 2021a: 13). It therefore plans to invest GPB 600 billion over the next five years in infrastructure.

4. Scope: Sectoral spending and timeframe differences

Analysis of the scale of green recovery funding showed that the three countries had different mixes of strategic motives and considerations. Looking at the scope of funding, in terms of sectoral allocation, and timeframes provides further insight into the specific choices each government made. Table 3 shows how each country allocated their green recovery funding across different sectors. While the plans show similarity in the 8-10 sectors targeted overall, they also marked differences in specific sector allocations. In Germany and the UK funding is more concentrated in a few sectors, while France's funding is spread more evenly across multiple sectors.

Sectors		France		Germany		United Kingdom	
4 top sectors	Railway infrastructure	4.70	*15.5%*	5.00	*18.2%*	4.72	27.2%
	Electric vehicles	3.38	*11.1%*	6.90	*25.1%*	3.25	18.7%
	Building energy retrofits	6.70	*22.1%*	2.00	*7.3%*	4.60	26.5%
	Hydrogen	2.00	*6.6%*	9.00	*32.7%*	0.27	1.6%
	Total	*16.8*	*55%*	*22.9*	*83%*	*12.8*	*74%*
Other sectors	Green transition (Unspecified) (a)	5.90	*19.4%*	0.40	*1.5%*		
	Air and maritime transportation	2.10	*6.9%*	3.20	*11.6%*	0.10	0.6%
	Environmental rehabilitation and protection	3.15	*10.4%*	0.70	*2.5%*	1.33	7.6%
	Urban commuting and mobility	1.20	*3.9%*			2.25	12.9%
	Agriculture, Aquaculture, Food, and Animals	1.05	*3.5%*	0.30	*1.1%*		
	Nuclear	0.20	*0.7%*			0.67	3.9%
	Renewables					0.18	1.0%
	Total	*13.6*	*45%*	*4.6*	*17%*	*4.5*	*26%*
Total		*30.38*		*27.5*		*17.3*	

Table 3: Green recovery spending sectors in EUR billion and %, (constructed using (French Government, 2020b; SPD, 2020; UK Government, 2020b, 2020c))

To allow for a cross-country comparison of the strategic motives behind the scope and timeframe of recovery spending, we further analyse country allocation choices for the four sectors and technologies that received the highest proportion of funding: railway infrastructure, electric vehicles, buildings energy retrofits, and hydrogen. The spending allocated to these four sectors represents 55% of the green recovery spending in France, 83% in Germany, and 74% in the UK.

4.1. France

Although the French EUR 30 billion green recovery plan aims to combine environmental sustainability and job creation for the short term with increased industrial productivity and economic growth for the long term, the allocation of green spending mostly focuses on *existing* sectors with potential immediate benefits for job creation: 22.1% of the spending was dedicated to building energy retrofits and 15.5% to railways infrastructure (Table 3). These sectors are well-established and lend themselves well for job creation in the short term. Investing in building energy retrofits allows expansion of construction industry jobs while also improving the energy performance of its buildings stock.

Additionally, both sectors are spread across the country, allowing the French government to allocate funds more evenly across regions. Support for improved housing conditions in more energy-efficient buildings and modernised railway infrastructure to support access to better train services thus fits the French government's objective to provide regional support and contribute to social justice.

The spending timeframe further reinforces this focus on stimulating existing sectors with high potential for green job creation. France allocates its budget between 2020 and 2023, with the majority of spending used by 2022. This relatively short timeframe corresponds with Macron's political ambition to deliver a recovery that allows France's economy to rebound before the 2022 presidential elections. While the focus is on existing sectors that bring green

jobs in the short term, the French government also invests some money in new technologies and sectors which foster industrial productivity and economic growth in the long term with electric vehicles receiving 11.1% and hydrogen 6.6% of funding (Figure 4).

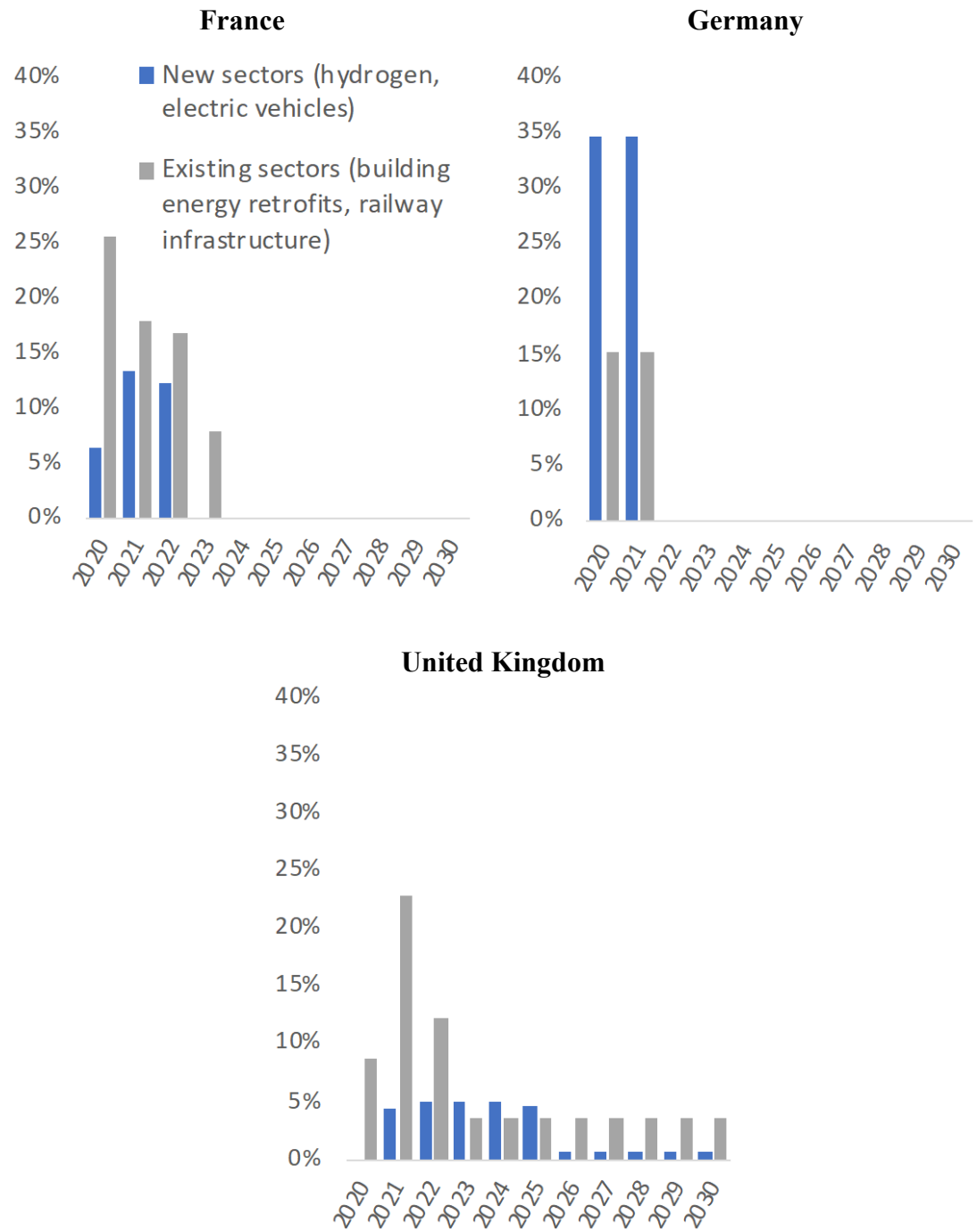

Figure 4: Country yearly spending, budget per sector group, (share (%) of country's total spending) (constructed using (French Government, 2020b; SPD, 2020; UK Government, 2020b, 2020c))

4.2. Germany

The scope of Germany's EUR 27.5 billion green recovery plan shows a different approach compared to France. Instead of focusing on short-term job creation in *existing* sectors, Germany's main focus is to modernize industry with a longer-term focus on harnessing new,

low-carbon technologies. Germany therefore concentrates its green spending on *new* sectors and technologies: 32.7% of the spending is dedicated to hydrogen and 25.1% to electric vehicles (Table 3). This also demonstrates Germany's intention to focus on industrial sectors that are central to its economy. Commentators have qualified this focused interventionist strategy as a "new approach that shows a country that is ready to make bold bets on its economic future" (Jennen and Delfs, 2020).

While these allocation decisions signal new technological directions, they also protect industries that currently contribute significantly to the country's exports and competitiveness, including automobiles, chemicals, and steel, which accounted for 12%, 8%, and 1% of exports in 2019 (Eurostat, 2021a). Support for electric vehicles (EV), for example, bolsters the market position of the German car industry against competition from the US, South Korea, and China. However, the EV contribution to decarbonisation will depend on the country's future progress towards renewable electricity, which in 2019 was 41% of the electricity mix (Eurostat, 2020d).

Although hydrogen spending aims to create a new growth sector, it also supports existing heavy industries such as steel and chemicals that can use hydrogen to decarbonize their production processes. Hydrogen use can also contribute to decarbonising heavy freight and heating, as will be further discussed below.

Its spending scope reinforces the view that while Germany's recovery plan includes green actions, environmental sustainability it is not the main driver of the choices. There is only marginal spending for building retrofits (7.3%) which contribute substantially to the country's GHG emissions (Eurostat, 2021c). The more substantial funding for railways infrastructure (18.2%) partly relates to the railway's support role for industry in transporting goods across the country, although it also aims to contribute to a modal shift of passenger from roads to rail. Germany's timeframe shows accelerated recovery spending designed to be spent over two years, between 2020 and 2021, without differences across sectors (Figure 4).

4.3. United Kingdom

The scope of the UK's green recovery plan bears similarity to that of France with a focus on existing sectors that stimulate short-term job creation, and of Germany with the objective of industrial modernization. Because the UK's budget timeframe is not entirely clear, we have interpreted some funding to be staggered over a longer time frame (Figure 4). While most money will be spent until 2022, some support may extend out to 2030.

The UK focuses on *established* sectors with 27.2% of the spending going to railway infrastructure and 26.5% for building energy retrofits. However, the recovery plan also contains some funding for long-term measures aimed at future productivity gains and industrial modernization with electric vehicles receiving 18.7% and hydrogen 1.6% of the spending (Table 3).

The timeframe across sectors varies significantly. While funding for buildings energy retrofit has a short-term focus, from 2020 to 2022, support for railways, electric vehicles and hydrogen spreads out up to 2030. This choice of timeframe suggests a reliance on the buildings sector, and the property market more generally, to drive the UK's immediate green recovery and job creation.

The scope of the spending suggests that the 'levelling up' agenda influenced the choice of sectors. Support for railway infrastructure, for example, fits the country's ambition to contribute to regional development. Hydrogen support has been promoted to help industrial decarbonization of coastal industry hubs, particularly in the North, thus contributing both to 'levelling up' and supporting industries in decline. A similar argument is behind the support for electric vehicles as the UK car production has been in decline for some years (O'Grady, 2020). However, the staggered timeframes for all sectors except building

energy retrofits suggests that 'levelling up' motivations may be less of a priority in the choice of sectors for a green recovery.

5. Implementation and delivery policies

The previous two sections have provided insight into differences in scale, scope and timeframes of the green recovery plans of France, Germany and the UK. That analysis identified high-level strategic motives and considerations behind the countries' allocation of green recovery spending across sectors. In this section, we further analyse the countries' implementation and delivery policies in the four sectors that received most support. This provides deeper insight into how these countries implement their green recoveries.

5.1. Hydrogen

Germany (EUR 9 billion) has allocated a much higher amount of green recovery spending to hydrogen than the UK (EUR 0.27 billion) and France (EUR 2 billion), although France will also spend EUR 5 billion through its parallel national hydrogen strategy. One reason for this difference is that Germany and France had pre-existing hydrogen strategies that green recovery plans could align with. Germany presented its national hydrogen strategy in June 2020, while France published its first hydrogen strategy in 2018 and a revised version in September 2020. The green recovery plans accelerated these long-term strategies by bringing forward investments initially planned for later stages. In contrast, the UK's inclusion of hydrogen in the TPP forestalls a long-term hydrogen strategy planned to be released in 2021 (UK Government, 2020c). So, while Germany and France reinforce pre-existing hydrogen strategies, the UK's approach is more exploratory as it serves to study the feasibility and market potential for different end uses.

Another reason for the spending difference is that chemical and steel industries, which are the biggest envisaged users of green hydrogen in all three countries, are larger in Germany than in France and the UK, both in terms of jobs and GDP contribution (Table 4). Germany is already the largest producer and consumer of hydrogen in Europe: it produced 4,5 billion m^3 in 2019, while France and the UK respectively produced 970 and 256 million m^3 (Eurostat, 2020e). Germany also has more completed and ongoing pilot and implementation projects with electrolysers (accounting for 60 MW capacity) than France and the UK (Table 5), which respectively have 2.3 MW and 3.5 MW installed capacity. This means that Germany has a stronger pre-existing techno-industrial base that can be expanded more quickly (and more realistically) than in France and the UK, where a 400-fold and 60-fold increase in the coming years (from completed/ongoing to planned project capacity) may prove challenging.

Sector	Indicator	France	Germany	UK
Chemicals	GVA	1.09%	1.69%	0.75%
	Jobs	0.44%	0.85%	0.34%
Metals	GVA	0.32%	0.75%	0.21%
	Jobs	0.27%	0.61%	0.20%

Table 4: Gross Value Added (GVA) and jobs per sector in 2018 (% of total GVA and jobs for each country) Source: (Eurostat, 2020a, 2020b)

Country	Completed/ongoing		Planned (2020-2023)	
	Projects	MW	Projects	MW
France	16	2.27	11	898.68
Germany	70	59.70	13	686.77
UK	12	3.53	9	200

Table 5: Number of hydrogen demonstration and early implementation projects per country (source: (IEA, 2020b))

In terms of implementation, all three countries aim to support hydrogen production and use. They have similar production goals for 2030, with Germany and the UK aiming for 5GW production capacity and France for 6.5GW. Germany and France focus on 'green' hydrogen production, which uses electrolysers to manufacture hydrogen from water. Both countries intend to use renewable electricity, although France keeps the door open for relying on nuclear power which represented 72% of the electricity mix in 2019 (Our World in Data, 2021). The UK target includes both 'green' and 'blue' hydrogen (from fossil fuels with carbon-capture-and-storage), which means it has not yet committed to a specific energy source or production technology, which may be due to the country's earlier hydrogen planning stage.

German and French hydrogen strategies align with the broader EU agenda to sustain leadership in more innovative electrolyser technologies. While China is world leader in the cheaper alkaline electrolyser due to its scale of production, the EU is currently leading in Proton Exchange Membrane (PEM) electrolysers. As PEM electrolysers are better able at handling intermittent electricity from renewables, they are more adequate for green hydrogen production (Janssen, 2020).

German and French strategies both distinguish a first phase (2020-2023) and a second phase (post-2023). Germany spends EUR 7 billion of its green recovery funding in the first phase to kickstart the development of hydrogen technology and domestic market. It spends the remaining EUR 2 billion in the second phase to expand domestic markets and develop foreign trade partnerships. The second phase will also receive funding from Germany's broader hydrogen strategy, including from the EUR 1.4 billion, National Innovation Programme on Hydrogen and Fuel Cell Technology, 2016-2026. France will spend half of its EUR 7 billion in the first phase, allocating 54% to industry applications, 27% to heavy-duty vehicles, and 19% to research and skills development. The other half will be spent in the second phase. The UK's EUR 0.27 billion (GBP 0.24 Billion) hydrogen funding will support the Net Zero Hydrogen Fund to stimulate the development of production capacity.

While all three countries envisage industries as the main hydrogen user, they also investigate potential use in hard-to-decarbonise mobility sectors such as aviation, shipping, freight trucking and regional railways (Gielen et al. 2019). The UK additionally considers heating as a potential application domain, which it intends to explore with various demonstration projects, including a 300-homes Hydrogen Neighbourhood. The hope is that hydrogen can be distributed through existing gas grids and used in homes, which may require appliance retrofitting. However, compared to industrial applications, these other potential applications receive much less funding in all three countries.

5.2. Electric vehicles

Germany (EUR 6.9 billion) allocates a higher amount of green recovery spending to electric vehicles (EVs) than France (EUR 3.38 billion) and the UK (EUR 3.35 billion). The main reason for this difference is that the car industry's economic importance is greater in Germany than in France and the UK, both in terms of Gross Value Added and jobs (Table 6).

Germany is also the world's top exporter, accounting for 18.6% of the worldwide vehicle export market in 2019, while the UK had 5.6% and France 3.16% (OEC, 2021). Since future global competition is expected to be all about EVs, Germany has a stronger economic motive to modernise its car industry, leading to larger green recovery funding for EVs (Eurostat, 2021h).

	France	**Germany**	**UK**
Gross Value Added (as % of total GVA)	0.64%	4.57%	0.89%
Jobs (% of total employment)	0.38%	2.02%	0.50%
% of total country exports	10.15%	20.92%	10.57%

Table 6: Economic importance of the manufacture of motor vehicles and trucks in 2018 (Source: Eurostat, 2021b, 2021c)

The three countries also had pre-existing climate-oriented EV strategies, which helps explain why they all provided green recovery support to EVs. Germany developed a *National Development Plan for Electric Mobility* in 2009, established a *National Platform for Electric Mobility* in 2010 that articulated the ambition to deploy 1 million EVs by 2020, formulated the *Electric Mobility Act* in 2015 and implemented a *Charging Point Regulation* in 2016 (which aimed for 43,000 charging points by 2020). France developed a *Clean Mobility Development Strategy* in 2016 (which articulated a target of 2.4 million EVs by 2023), a multi-year *Energy Programme* in 2019 (which lowered the target to 1.33 million EVs in 2023 and aimed for 100,000 electricity charging points by 2023), and a *Law on Mobility* in 2019 (which supported EVs in various ways). The UK published an *Ultra Low Emissions Vehicle Strategy* in 2009, *Electric Vehicle Infrastructure Strategy* in 2011, and a *Road to Zero Strategy* in 2018 which not only stimulated EVs, but also banned the sale of diesel and petrol vehicles by 2040. This sales ban was subsequently brought forward to 2030 for diesel and petrol cars and to 2035 for hybrids.

Although the diffusion of Battery-Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEV) has accelerated in all three countries (Figure 5), they are not on track to meet their stated targets. With respectively 305,800 and 275,500 EVs on the road in 2019, Germany and France are quite far from their goals. The UK had 274,600 EVs in 2019, which means that the feasibility of the 2030 diesel and petrol ban is not guaranteed. For recharging infrastructure, Germany had 39,291 charging points in 2019, which is relatively quite close to its 43,000 target for 2020. France had 29,701 charging points in 2019, which is still far off from the 100,000 target for 2023. The UK has no charging point target, but with 27,094 charging points in 2019 lagged behind Germany and France.

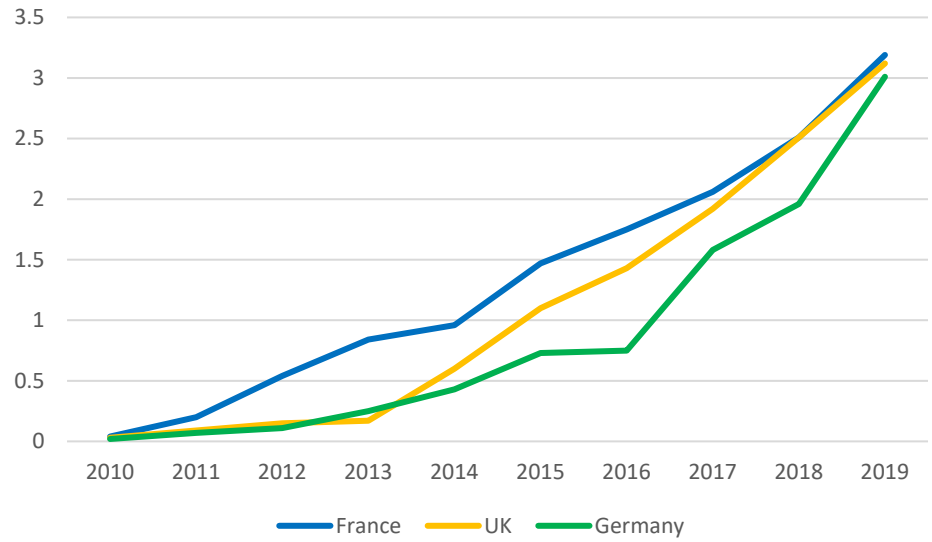

Figure 5: Combined share (%) of new BEV and PHEV vehicle registrations relative to total new vehicle registrations (Source: (AVERE, 2021; German Government, 2021; UK Government, 2021b)

To accelerate EV adoption and support their car industries in the global EV race, all three countries allocated green recovery funding to similar implementation categories (industry, demand, recharging infrastructure). Nevertheless, they differ in specific allocation choices (Table 7). Germany chose a comprehensive 'whole system' approach, allocating similar amounts to industry, infrastructure, and purchase, with private consumers receiving more subsidies than public agencies. France supported industry and demand but allocated no funding to charging infrastructure. The UK allocated similar amounts to industry and charging infrastructure but provided less purchase subsidies for consumers and none for public actors. In early 2021, the French and UK governments lowered purchase subsidies per electric vehicle, which arguably sends the wrong signal in the context of delivering a green recovery (Jolly, 2021).

	Automobile industry	**Automobile purchase**		**Charging infrastructure**
		Private consumers	**Public sector/NGOs**	
France	1.3	1.9	0.18	-
Germany	2	2.2	0.2	2.5
UK	1.13	0.65	-	1.46

Table 7: Implementation choices for electric vehicle government funding, EUR Billion (constructed using (French Government, 2020b; SPD, 2020; UK Government, 2020b, 2020c))

All three countries provide financial support for the EV reorientation of their car industries and suppliers, using R&D subsidies, grants and loans for investing in new technologies, processes, and systems, including batteries, motors, electronics, and fuel cells. Germany spends more on industry modernisation than France and the UK, not only to support its existing car industry, but also to attract new investments in battery manufacturing plants (Eddy, Pfeiffer, and Staaij, 2019). Many global automakers and component suppliers are presently assessing where to build these new plants, so countries are competing in attracting

them. Tesla, for instance, decided to build a new Gigafactory (for batteries and cars) in Germany, finding the UK less attractive due to Brexit (Eddy et al., 2019).

One further consideration for Germany's EV push is that the 2015 'Dieselgate' scandal (which exposed that automakers cheated and manipulated emission tests) angered German policymakers and made them more willing to adopt an interventionist approach (Reguly, 2021). Rather than using cash-for-clunkers schemes to address the industry's short-term problems, such as collapsing car sales due to dealership lockdowns, German policymakers used the green recovery packages to push automakers more strongly towards longer-term EV reorientation.

5.3. Building retrofit

France allocated a significant amount of its green recovery spending to building retrofits (EUR 6.7 billion), followed by the UK (EUR 4.6 billion) and Germany (EUR 2 billion). The renovation sector is labour-intensive, employing roughly similar percentages of the working population in all three countries (Table 8). The different funding allocations thus relate less to sectoral size and more to the importance of job creation and climate mitigation in the green recovery packages, which are both larger in France and the UK than in Germany as section 3 indicated. The UK government also used green recovery funding to partly deliver on its 2019 election manifesto promise to spend GBP 9.2 billion on improving energy efficiency in buildings.

	Jobs residential building sector	**Jobs in non-residential building sector**	**Total jobs**	**Share of total country jobs**
France	639,671	296,872	936,543	3.43%
Germany	857,526	428,693	1,286,219	3.01%
United Kingdom	672,829	197,115	869,944	2.83%

Table 8: Jobs in residential and non-residential renovation sectors, per year on average for the period 2012-2016 (Source: European Commission, 2019)

All three countries had pre-existing energy efficiency plans for buildings, which struggled with implementation and delivery. Germany's 2014 *Climate Action Programme 2020* developed building sector plans, which were further detailed in the 2014 *National Action Plan on Energy Efficiency*. The 2016 *Climate Action Plan 2050* aimed for 66% GHG emission reduction in the building sector by 2030, and the 2019 *Climate Action Programme 2030* proposed specific actions, including retrofit subsidies and stronger building standards. The 2019 *Building Energy Act* also introduced tax incentives for buildings energy efficiency renovations. Delivery has been slow, however, due to limited homeowner uptake and uncertainties in the complex network of stakeholders that deliver energy efficiency programmes (Amoruso, Donevska, and Skomedal, 2018).

France's 2015 *Energy Transition for Green Growth Law* articulated actions such as the obligation to meet minimum energy performance standards when major renovations take place. Its 2018 *National Low Carbon Strategy* also recognised the importance of the building sector and set a sectoral target of 49% GHG emission reduction target by 2030. France's 2018 *Plan for the Energy Renovation of Buildings* made energy efficiency in buildings a national priority, which helps explain the large amount of green recovery funding to building retrofit (French Government, 2020c). Despite the commitments, 40% of energy efficiency renovations are light in the performance improvements delivered, so there is a need for deeper retrofits (Sebi et al., 2019). France is also falling behind its annual 500,000 extensive renovation goal (IEA, 2017; Rüdinger, 2020).

UK energy efficiency policies for buildings have weakened in the past decade, because the 2013 *Energy Supplier Obligation* delivered measures at a lower rate than

previous programmes. The 2013 pay-as-you-go *Green Deal* retrofit policy was a failure, and the Zero-Carbon Homes target for new homes was scrapped in 2015 (Rosenow and Eyre, 2016). The 2017 *Clean Growth Strategy* set targets for halving energy use of new buildings by 2030 and upgrading buildings of fuel poor households to EPC standard C, but has not been followed up with actual implementation policies.

These pre-existing plans, targets and implementation struggles help explain why all three countries dedicated green recovery funding to building retrofit, although amounts varied substantially. The countries also made different choices for the implementation and delivery of the allocated funding.

One difference relates to spending allocation across public and private building segments (Table 9). France spends twice as much on public buildings as on private houses, which suggests a strategy in which the public sector leads by example and drives momentum in the delivery of energy efficiency improvements. The UK took the opposite approach, spending almost three times more on private houses than on public buildings, which resonates with the wider view that housing, and the property market more generally, are core drivers of economic growth. Germany, which spends significantly less on building retrofits, does not direct its funding to particular segments.

	Public sector	**Private sector**		
		Residential privately owned	**Social housing**	**SMEs**
France	4	2	0.5	0.2
Germany	2 (shared between public and private sector)			
UK	1.17	3.37	0.06	-

Table 9: Green recovery support for building energy efficiency measures, EUR billion. (constructed using (French Government, 2020b; SPD, 2020; UK Government, 2020b, 2020c))

A second difference relates to contrasting choices for supporting piecemeal measures and 'whole-building' retrofits. France's public buildings support focuses on innovative whole-building retrofits including renewal of major building components (e.g., insulation, upgrades to safety, accessibility, and comfort), but also allows piecemeal measures (e.g., control and regulation of heating systems, and modernisation of lighting) (French Government, 2020e). France's residential sector support instead focuses on piecemeal measures with a support bonus when the renovations lead to a higher threshold of energy performance (Garnier, 2021). Germany's programme also supports 'whole-building' retrofits (i.e., full renovation to meet a pre-set efficiency standard with higher financial support for deeper efficiency improvements) and piecemeal measures. The UK only focuses on piecemeal measures, including low-carbon heat, windows and doors, and heating controls and insulation for the private sector (UK Government, 2020a) and insulation, glazing, heating controls, and heat pumps for the public sector (SALIX, 2021).

A third difference relates to delivery mechanisms. Germany channels its funding through an existing programme, while France and the UK created new programmes, which entail risks. Germany allocated all funding to the CO_2 Building Refurbishment programme, in operation since 2006. This implementation approach uses existing administration and delivery processes and enables quicker implementation (IEA, 2020a). The approach has been criticised, however, because the programme focuses more on new rather than existing buildings and frequently implements the lowest threshold of energy efficiency improvements (DUH, 2021). It thus seems to focus more on jobs and industry support than on climate mitigation, which resonates with Germany's economic recovery motivations discussed in section 3.2.

For the public sector and social housing, France allocated most funding to new programmes through calls for innovative project proposals. For residential homes, France allocated funding mostly to an existing programme that had just begun in January 2020 ('MaPrimeRénov') (French Government, 2020d).

The UK created a new programme, the Green Homes Grant, which faced implementation problems since the start, including registration problems for installers and slow project approval and payment procedures. These problems hampered uptake and resulted in discontinuation of the scheme in March 2021, six months after its launch (Harvey, 2021).

5.4. Railways

Germany (EUR 5 billion), France (EUR 4.7 billion) and the UK (EUR 4.72 billion) allocated similar amounts of green recovery spending to railway support. These investments are surprisingly large, considering the limited direct economic significance of the railway sector, which in 2017 accounted for 0.3% of employment in France, 0.2% in the UK (0.2%) and 0.1% in Germany (European Commission, 2020). We argue, therefore, that the funding decisions relate both to broader economic and political motivations and to pre-existing climate and mobility plans, which we discuss below.

Germany aims to support the state-owned railway company Deutsche Bahn, which operates both trains and railway infrastructure, in the modernization, expansion, and electrification of the rail network. Germany's green recovery spending for the railway infrastructure is motivated by recent forecasts that expect rail freight transport will increase by 43% between 2010 and 2030 and rail passenger transport by 19% in the same period (German Government, 2018). It also aligns with pre-existing plans such as the 2013 *Mobility and Fuels Strategy*, which aims to contribute to a modal shift from road to rail transport, particularly for freight transport where large growth is expected. To prevent an increase in diesel goods vehicles, the German government aims to shift freight to the railways, which are 63% electrified in Germany (German Government, 2018), compared to 57% in France, and 41% in the United Kingdom (Eurostat, 2021i). The sizeable green recovery railway investments thus contribute to achieving these pre-existing climate and mobility plans.

Additionally, they are an indirect way of supporting German manufacturing industries, which transport many supplies and outputs via railways: metals and metal products, metal ores, coal, petroleum, and chemicals accounted for 56% of Germany's rail freight transport (Eurostat, 2021c). Because of their links to manufacturing industries, German railways accounted for 19.8% of total freight transportation, which is much larger than in France (9.9%) and the UK (9.4%) (Eurostat, 2021g).

France supports the modernisation and resilience of the railways, which is seen as a strategic sector with internationally competitive train manufacturers (e.g., Alstom, Bombardier) and a state-owned railway company (SNCF) that operates trains and maintains rail infrastructure. Green recovery support aims to improve the overall quality of the rail networks so that it can efficiently accommodate increased rail travel for passenger and freight transport. Estimates indicate that passenger and freight rail transport may increase by respectively 20% and 15% between 2015 and 2028 (French Government, 2019b: 39).

The sizeable green recovery investments also align with France's pre-existing plans such as the 2016 *Strategy for the Development of Clean Mobility*, which aims to support road to rail modal shifts for both passenger and freight transportation by investing in rail infrastructure (French Government, 2019b). The 2019 *French Mobility Law* established the legal framework for the implementation of this strategy (French Government, 2019a), so

there was a pre-existing framework into which the green recovery funding could be slotted, supported by broader societal and political perceptions of the significance of railways.

The UK's EUR 4.72 billion funding aims to improve both railway infrastructure and urban public transport. It plans to electrify more railway lines, replace the existing franchising model with a more effective system, and to create integrated bus and train networks in more places, with smart ticketing, more frequent services, and bus lanes to speed up journeys. These investments resonate with pre-existing plans such as the 2016 *Rail Freight Strategy* (UK Government, 2016), which aims to shift road freight to the railways and support low-carbon alternatives to car journeys such as buses and trains (UK Government, 2017).

The UK's focus on railways is also motivated by the desire to 'level up' railway infrastructure across regions, underpinned by both economic and electoral motivations, as noted in section 3.3. The UK government further aims to expand rail routes around large regional cities and improve public transport in city regions to make it as good as London's. In smaller cities, the government wants to restore rail links removed in the past and to support modal shifts from roads to railways (UK Government, 2020c). The focus on building new infrastructures also boosts construction, which UK policymakers view as an important economic sector and aligns with the Treasury view that infrastructure investment drives economic growth.

6. Discussion

The previous sections showed that the green recovery plans of France, Germany, and the UK differ substantially in scale, scope, and implementation choices. They also identified underlying differences in motivations and strategies. France allocates most resources to green recovery (both absolutely and in relation to GDP) but spreads it quite broadly across many sectors, social groups, and constituencies. Existing sectors such as railways and housing receive 37.6% of funding, most of which is scheduled to be spent relatively quickly (between 2020 and 2022). The main motivations are to stimulate climate mitigation, green transition, job creation and GDP restoration before the 2022 Presidential election, alignment with European priorities, social justice/fairness, regional support, industrial productivity, and rebranding of the President as a green, visionary transformer.

Germany also committed sizeable investments to green recovery, to be spent within two years, focusing 57.8% of funding on two new technologies (electric vehicles and hydrogen) in the context of global innovation races. The main motivation is to boost the country's long-term economic growth and exports by accelerating the growth of new industries (electrolysers and hydrogen manufacturing) and the reorientation of existing export-oriented industries (automobiles, chemicals, steel). Other considerations such as climate mitigation and alignment with European priorities were additional to the main strategy, which pre-dated the COVID-crisis.

The UK spends 43% less on green recovery than France and allocates 53.7% of funding to two existing sectors (railways and buildings). Some spending timeframes are unclear, but substantial sums appear to be spread until 2030, which reduces its annual punch. The main motivations are to stimulate short-term job creation, decarbonisation, climate leadership reputation (as COP-26 host), regional support ('levelling up'), party-politics, and economic growth (by supporting housing and infrastructure construction).

Combining sectoral focus and implementation speed, Table 10 summarises salient differences in country strategies. These differences relate to actor choices and different contexts, such as varying effects of the crisis ('productive conditions') and pre-existing concerns, plans and initiatives ('critical antecedents').

France's contextual conditions include pre-existing concerns about social and regional inequalities, high unemployment (which COVID exacerbates), and struggling industries. France also had pre-existing net-zero commitments and sectoral climate mitigation plans which green recovery spending could build on.

Germany's contextual conditions include the economic importance of manufacturing industries, pre-existing concerns about stagnating exports in globally competitive markets, and pre-existing climate commitments and sectoral strategies. These conditions provided motives for Germany's green recovery strategy and provided credible technological and organizational capabilities to implement it.

The UK's contextual conditions include pre-existing concerns about the labour market (and that COVID would trigger mass unemployment), pre-existing net-zero commitments and developed climate strategies in some sectors (e.g., electricity, electric vehicles) but not in others (e.g., housing, hydrogen), a weakening industrial base, and the relative absence of credible industrial strategy.[6]

	Slower implementation	**Faster implementation**
Emerging industries and sectors		*Germany*: Focused acceleration of new technologies and industries, as part of repositioning in global races.
Existing industries and sectors	*United Kingdom*: Gradually reorienting existing sectors (with some exploration of new ones)	*France*: Spreading resources to rapidly support green reorientation in many (mostly existing) sectors.

Table 10: Typology of green recovery strategies in Germany, France and the UK

These differences do not necessarily imply that one green recovery strategy is better than another. In fact, each country strategy has been criticised for how they navigate trade-offs. The German package, for instance, has been criticized for over-privileging industry and under-privileging sustainability considerations (Mahler, 2020; Wuppertal Institute and E3G, 2021). Furthermore, its focus on a few green technologies may improve Germany's long-term competitive position if future markets materialise. But 'big bets' can also fail, which especially for hydrogen is not inconceivable. France's strategy of spreading resources across many sectors may increase public and business support. But, as a trade-off, they may also dilute resources and reduce their transformative effects. The UK's green recovery package has been qualified as a vision rather than a plan (Hook et al., 2020), because it provides limited clarity about implementation and long-term funding. Others criticized it for the lack of a "strategic plan for delivering net-zero by 2050" (Phillips and McKay, 2020). Its focus on large-scale technologies and infrastructures (such as nuclear power, carbon-capture-and-storage, hydrogen) has also been criticized as "a scattergun approach that is (…) wasteful and likely to be ineffective" (CREDS, 2020).

7. Conclusions

Many analyses of COVID green recoveries assume or suggest that the shock has wiped the slate clean, which would allow policymakers to develop and commit to green recovery plans. We suggest that such analyses are too simple. Rather than having free agency, our findings show that policy responses to the crisis were strongly shaped by country- and sector-specific contexts and by pre-existing plans. Analysis of these contexts was essential to understand the motivations and choices in the green recovery plans of France, Germany, and the UK.

[6] An industrial strategy was reintroduced in 2017, but scrapped again in 2021, when the Treasury reclaimed authority over economic strategy.

Our findings also show that the green recovery plans were based on multiple motivations, which not only included 'green' considerations but also various economic, industrial, party-political, social, and regional considerations. Although many sustainability scholars dislike such compromises and would rather see 'green' considerations dominate (Alcott, 2008; Kallis, 2011), these conclusions suggest that ecological modernization or green growth strategies, which aim to combine ecological, economic and social goals, have greater real-world political traction, especially when large investment decisions are being made.

A third conclusion is that green recovery plans are not only about the scale and scope of funding, but also involve a myriad of more detailed implementation choices. These choices differed substantially between our three countries. For electric vehicles and hydrogen, Germany uses a more systemic and comprehensive approach, addressing supply, demand, and infrastructure. France uses a systemic approach for hydrogen but is somewhat less systemic with EVs by not funding recharging infrastructure. The UK has small and mostly exploratory hydrogen implementation plans, but a more comprehensive approach to electric vehicles, although its demand-side support is relatively small (and reduced further recently). Unpredictable, ad-hoc changes also characterised UK implementation of the Green Homes Grant, which was poorly administered and scrapped after six months. France created a new delivery programme for innovative whole-building retrofits in the public sector, while using an existing programme to deliver more piecemeal measures in private buildings. Germany used an existing programme to implement its housing support, which is relatively small and undifferentiated.

Most of the countries' green recovery implementation choices build on pre-existing strategies and plans (except for UK hydrogen), for which they increased funding amounts and brought forward delivery milestones. This reinforces our conceptual point that policy responses to a crisis are strongly shaped by existing repertoires, plans, and ongoing initiatives. This conclusion also resonates with the idea in socio-technical transitions theory (Geels et al., 2017) that disruptive exogenous shocks can generate windows of opportunity for existing niche-innovations. Instead of understanding crises as providing a 'clean slate' for choosing completely new directions, they are thus better interpreted as providing opportunities for the acceleration of pre-existing developments.

These conclusions imply that commitments to green recovery are partly path dependent so that countries that were leading pre-COVID in green technology deployment and GHG emission reductions (Le Quéré et al., 2019), green technology manufacturing (Lachapelle et al., 2017), and environmental governance (Duit, 2016) are more likely to develop green recovery plans. These criteria apply to the three countries we analysed, although France and the UK are not leaders in green manufacturing (Lachapelle et al., 2017). But the criteria also apply (in varying degrees) to several other countries such as Denmark, South Korea, Finland, Sweden, United States, Norway, and Spain, which in late 2020 or early 2021 did indeed adopt (or strengthen) green recovery packages (UNEP, 2021; Vivid Economics and Finance for Biodiversity Initiative, 2020). They also apply to China and Japan, which have so far only weakly committed to green recovery.

These criteria (and less fiscal space for increased government spending) apply less to many other countries in the world, which helps explain why the majority of countries have not (yet) developed green recovery plans (UNEP, 2021; Vivid Economics and Finance for Biodiversity Initiative, 2020). On the positive side, the window of opportunity for increased green spending is still open, because many countries are beginning to shift their attention from short-term support policies to longer-term recovery plans. There is not 'one right way' for countries to design green recovery plans, since underlying motivations, economic strengths, and green commitments are likely to vary substantially, as our three-country

analysis showed. Nevertheless, we hope that our detailed analysis of real-world green recovery packages will support deliberations and design choices in other countries.

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