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COMMISSION STAFF WORKING DOCUMENT

Analysis of the recovery and resilience plan of Germany

Accompanying the document

Proposal for a COUNCIL IMPLEMENTING DECISION

on the approval of the assessment of the recovery and resilience plan for Germany

{COM(2021) 341 final}

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1. EXECUTIVE SUMMARY

Germany's economy was hit hard by the COVID-19 pandemic and the repeated lockdowns, but sizable policy support mitigated job losses. The economy contracted by 4.8% in 2020. After a nascent economic recovery in the second half of 2020, soaring new infection numbers in autumn brought new lockdown restrictions as of November 2020, which were gradually tightened and extended in the following months. As a result, gross domestic product shrunk by 1.8% in the first quarter of 2021, but a marked recovery is expected from the second half of 2021, as vaccinations progress and the economy reopens. Substantial government support for the economy, in particular the extensive short-time work scheme (*Kurzarbeit*), protected the labour market throughout the crisis and limited the losses in employment to 1.1% in 2020, while unemployment increased relatively moderately (to 3.8% in 2020 from 3.1% in 2019).

The measures to cushion the consequences of the crisis reversed the budget balance into a sizeable deficit. After years of fiscal surpluses, the measures to support the economy during the pandemic caused a budget deficit of 4.2% of GDP in 2020, which is likely to increase even further in 2021. General government debt had fallen below the Maastricht threshold of 60% of GDP in 2019 after a steady downward path in the years before, but it jumped up to 69.8% in 2020 and is expected to peak at 73.1% in 2021, before declining again in 2022. Despite higher deficits and increasing debt, risks to fiscal sustainability are limited so far, thanks to the sound starting position of public finances.

Germany can expect up to EUR 25.6 billion in non-repayable support from the Recovery and Resilience Facility. The recovery and resilience plan amounts to EUR 27.9 billion (0.81% of 2019 GDP) and does not include a request for loans. Excluding value-added tax, it corresponds to a net amount of at least EUR 26.5 billion, slightly above the maximum financial contribution of EUR 25.6 billion (0.74% of 2019 GDP) that Germany can expect from the Recovery and Resilience Facility Regulation¹.

The plan promotes the Union's economic, social and territorial cohesion and supports the recovery of Germany's economy and contributes decidedly to a more green, digital, inclusive, and resilient future². The six priorities of the plan center on the green and digital transitions, but also strengthen social resilience. They are: 1 Climate policy and energy transition, 2 Digitalisation of the economy and infrastructure, 3 Digitalisation of education, 4 Strengthening social inclusion, 5 Strengthening a pandemic-resilient healthcare system, and 6 Modern public administration and reducing barriers to investment. The 40 measures included in the plan cover all the seven European flagship areas, with a particular focus on Recharge and

¹ The final maximum financial contribution will be calculated in June 2022.

² Germany submitted its National Reform Programme on 13 April 2021. The information provided in the National Reform Programme is being considered and jointly assessed in this Staff Working Document together with the Recovery and Resilience Plan.

Refuel, Modernise, and, for the hydrogen-related elements, Power Up. The plan has a strong cross-border dimension with three planned Important Projects of Common European Interest – on renewable hydrogen, microelectronics, and cloud.

The recovery and resilience plan responds to the most relevant structural challenges Germany faces, as identified in the context of the European Semester. Together with the extensive measures from the national stimulus package of June 2020, the plan gives impetus for a short-term economic recovery and provides a long-term strategic response to the most pressing economic policy challenges. These relate mainly to the need to boost public and private investment, in particular for the green and digital transitions, in sustainable transport, in clean, efficient and integrated energy systems, in the digitalisation of the public administration and health services, in education, and in research and innovation. Further challenges addressed to some extent include the need to reduce disincentives to take up work, including the high tax wedge, in particular for low-wage and second earners, and the long-term sustainability and adequacy of the pension system. The reforms and investments included in the plan address a significant subset of the recent country-specific recommendations addressed to Germany by the Council and are also in line with the most recent Draft Council Recommendation on economic policy in the euro area³.

The plan refers to the six policy pillars in Article 3 of the Regulation establishing the Recovery and Resilience Facility⁴. Germany's recovery and resilience plan has a strategic focus on the challenges of the green and digital transitions. Investments and reforms address administrative bottlenecks and foster smart, sustainable and inclusive growth, while also benefitting small and medium-sized enterprises. Social cohesion is promoted through measures to support disadvantaged groups, cap social security contributions, and strengthen education and skills, in particular by supporting the digitalisation of education. Efforts to accelerate planning procedures, to help municipalities manage investment subsidies, and digitalise their schools are expected to help areas with infrastructural challenges, thus contributing to territorial cohesion. Cross-border initiatives in the plan are expected to contribute to cohesion and convergence in the EU. Public administration reforms and investments to strengthen the healthcare system are expected to contribute to increased resilience, as do measures to digitalise and modernise public services and to reduce barriers to investment. Various skills-related measures benefit the next generation.

The reforms and investments included in the plan have the potential to contribute to the green transition of Germany's economy and to the protection of the environment. They are expected to support Germany's decarbonisation and energy objectives and are thus a step

³ Pending final adoption by the Council, after endorsement by the European Council. The text agreed by the Eurogroup on 16 December 2020 is available at: <https://data.consilium.europa.eu/doc/document/ST-14356-2020-INIT/en/pdf>

⁴ Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility

towards achieving climate neutrality by 2050 – or even earlier, considering that the target is expected to be advanced to 2045. Measures in the area of climate action and the energy transition include significant efforts for the development of a well-functioning hydrogen economy, measures to promote climate-friendly mobility, and sizeable investment in energy-efficient building renovation. At least 42.4% of the financial contribution is expected to go to measures supporting climate change objectives⁵. All measures in the German plan have passed the ex-ante assessment of the ‘do no significant harm’ principle.

The plan is ambitious in its aim to catalyse the digital transition and address the challenges related to it. Six out of the ten components contain measures to support the digital transition. These include investments in key advanced technologies, but also in the digital transformation of the automotive industry, and in the digitalisation of the healthcare sector, of education, and of the public administration. The digital target of 20% is clearly exceeded with at least 52.6% of the expected financial contribution serving digital objectives.

The recovery and resilience plan has the potential to make a lasting impact on Germany’s economy and society by inducing structural changes to its administration, institutions, and policies. The most relevant measures in this respect include the support for the digitalisation of the public administration and health services, the assistance to municipalities in their investment projects, the expected improvement of support outflows for public investment, and the acceleration of planning and approval procedures, which should improve the uptake of the significant public and private funds for investment in infrastructure. All these are expected to accelerate the structural changes related to the green and digital transition, which are present across all parts of the plan. Most importantly, removing investment barriers is one of the priorities of the plan. An adequate monitoring of the plan’s implementation is enabled by clear and comprehensive milestones and targets that track the adoption of key legislation, budgetary execution and delivering changes on the ground, such as the creation of childcare places.

The overall strategy and the measures contained in the plan are coherent. Within each component, measures support and reinforce each other and reforms and investments across components are well aligned. For example, the investment and research support for the economy’s digital transformation is complemented by reforms on data infrastructure and investments in digital education and skills, which are closely linked to the digitalisation of the public administration and the health sector. The measures’ objectives are also well embedded in European and national initiatives.

Germany has provided cost estimates for all investments included in the plan and put in place strong control systems. Based on the costing information provided, the cost estimates and supporting documents broadly comply with the principles that costs must be justified, reasonable, plausible, commensurate, and in line with the principle of cost-efficiency. The cost

⁵ The effective climate contribution may be slightly higher, see footnote to table 6.

breakdowns are generally satisfactory, yet they show varying degrees of detail and depth of calculation. Germany has demonstrated that the measures in the plan will be subject to strong governance and control systems and has given assurances that the measures funded under the German recovery and resilience plan will not receive funding from other existing or planned EU financing.

(1) Balanced Response	(2) CSRs	(3) Growth , jobs...	(4) DNSH	(5) Green target	(6) Digital target	(7) Lasting impact	(8) M & T	(9) Costing	(10) Control System s	(11) Coherence
A	A	A	A	A	A	A	A	B	A	A

2. RECOVERY AND RESILIENCE CHALLENGES: SCENE SETTER

2.1 Macroeconomic outlook and developments

The pandemic has led to a sharp decline in economic activity. GDP declined by 4.0% in 2020, reflecting the global recession and severe limitations on travel, social, and leisure activities. Over the year, there were large swings in economic activity, declining by 2% in the first quarter and by an unprecedented 9.8% in the second. In the third quarter, GDP rebounded by 8.5%, benefiting from the partial lifting of confinement measures and the normalisation of foreign trade. This resulted in a partial resumption of activity in both industry and services. The fourth quarter of 2020 saw infection numbers soar, which required restrictions to be reintroduced on various services, prompting them to curtail activity. A contraction was nevertheless avoided, with GDP increasing by 0.5% as industry posted robust growth, while consumer spending partially switched from services to goods.

The economy is expected to recover in 2022. Economic activity declined again in the first quarter of 2021, by 1.8%. With confinement measures in place in Germany and in neighbouring countries, consumer spending and exports are expected to remain depressed in early 2021. However, as more people get vaccinated and infection rates fall, restrictions are set to ease in subsequent quarters. A number of other factors should also favour a resumption of the economic rebound. Strong industrial sentiment suggests that export growth is set to remain robust. Government support for businesses is expected to avert a wave of insolvencies, and employment growth should resume in 2022. In the 2021 Stability Programme⁶, the unemployment rate in 2022 is projected at 3.5%, down from expected 3.9% in 2021 and 4.0% in 2020, although somewhat higher than in 2019. Accumulated savings should spur a recovery in consumer spending, which will also benefit contact-based service sectors. In the meantime, investment is

⁶ The recovery and resilience plan refers to the 2021 Stability Programme for issues related to the macroeconomic and fiscal outlook.

expected to start picking up. Real GDP is forecast to rebound by 3.0% in 2021 and continue to grow by 2.6% in 2022 returning to its pre-crisis level in the course of the year.

Inflation is set to increase moderately. HICP inflation fell from 1.4% in 2019 to 0.4% in 2020 (from 1.4% to 0.5% for the national CPI). CPI inflation is expected to rise to 1.5% in 2021 and 2022, according to the Stability Programme. The economy still operates below capacity; however energy prices are expected to drive inflation up, also in light of adjustments in CO₂ pricing. So are the reinstatement of the regular VAT rates and the high housing demand in metropolitan areas.

The labour market has been cushioned by the government-backed short-time work scheme (*Kurzarbeit*) but faces structural challenges. The COVID-19 crisis led to a sizeable reduction of hours worked, although most of this was absorbed by expanding the short-time work scheme, used by almost 6 million workers (14% of the labour force in April and May 2020). Support measures have been extended to non-standard workers (those not covered by full-time open-ended contracts) such as temporary agency workers, seasonal workers and apprentices, who tend to be more exposed to labour market shocks. Employment loss was limited to 1.1%. Participation in training and adult learning was incentivised and additional financial resources have been committed to increase the number of apprenticeships. Structural transformation is expected to keep unemployment at a somewhat higher level than in the past, requiring support measures for training and reallocation of resources.

Table 1. Comparison of macroeconomic developments and forecast

	2019	2020		2021		2022		2023	2024	2025
	COM	COM	RRP	COM	RRP	COM	RRP	RRP	RRP	RRP
Real GDP (% change)	0.6	-4.9	-4.9	3.4	3.0	4.1	2.6	1.2	1.2	1.2
Employment (% change)	0.9	-1.1	-1.1	-0.2	0.0	0.9	0.6	-¼	-¼	-¼
Unemployment rate (%)	3.1	3.8	4.0	4.1	3.9	3.4	3.5	3¾	3¾	3¾
HICP inflation (% change)	1.4	0.4	n.a.	2.4	n.a.	1.4	n.a.	n.a.	n.a.	n.a.
General government balance (% of GDP)	1.5	-4.2	-4.2	-7.5	-9.0	-2.5	-3.0	-1½	-½	0.0
Gross debt ratio (% of GDP)	59.7	69.8	69.8	73.1	74½	72.2	74.0	73¼	72.0	69¼

Source: Commission Spring Forecast 2021 (COM), recovery and resilience plan (RRP) Note: end April the national statistical institute revised the GDP decline for 2020 from 4.9% (that was also relayed in the Spring Forecast) to 4.8%.

The COVID-19 pandemic is likely to increase social vulnerability. Overall, Germany performs well in the Social Scoreboard⁷, which supports the European Pillar of Social Rights (see also Box 3). There have been improvements in living conditions, poverty, and labour market conditions in recent years. The share of people at risk of poverty or social exclusion declined from its peak of 20.6% in 2014 to 18.7% in 2018 and fell further to 17.4% in 2019. In 2020, the country also took measures to alleviate the social consequences of the crisis beyond the labour market. It made it easier to access minimum income support and supported low-income families through easier access to child allowances. In addition, tenants facing a loss of income were temporarily protected against eviction. Nonetheless, people in vulnerable situations, e.g. without the possibility to work from home or without liquid assets, were exposed to hardship, and the increase in vulnerability may merit monitoring and possibly further action.

The government swiftly took far-reaching measures in response to the COVID-19 pandemic, while continuing to maintain a sustainable public debt ratio. The government adopted measures of historic proportions to fight the COVID-19 pandemic and stabilise the economy, estimated to 3½% of GDP in 2020 and 6¼% in 2021. They include financial support for small and medium-sized enterprises (SMEs), easier access to the short-time working scheme, additional health spending, and equity investment in rail and air transport. In addition, some 25% of GDP (around EUR 800 billion) was provided in the form of public guarantees for loans. The budget deficit was reported to be 4.2% of GDP in 2020, and the Stability Programme (BMF, 2021) anticipates a return to positive territory by 2025 as the measures are phased out. For 2021, the Stability Programme expects a deficit of 9%. After an increase in the debt-to-GDP ratio from just below 60% in 2019 to around 70% due to the combined effect of shrinking GDP and support measures in 2020, debt is expected to rise further to 74½% in 2021 before starting to fall to reach 69¼% in 2025. In comparison, DG ECFIN's Debt Sustainability Monitor of early 2021 (European Commission, 2021a) projects debt to be 70.1% of GDP in 2021 and to decline to 58.7% of GDP in 2030.

The current account surplus remains high. Following a gradual decline since 2015, it eased further by 0.5 percentage points to 7% of GDP in 2020. The trade surplus narrowed from 6.3% to 5.7% of GDP in 2020 as exports contracted more than imports. However, the service balance turned from -0.6% to neutral due to travel restrictions. The income balance deteriorated slightly. On the domestic side, the sharp fall in government savings was largely counterbalanced by a surge in private savings, reflecting private consumption constrained by restrictions and suspended contact-intensive services, as well as a strong fiscal support for household incomes. While there was a substantial acceleration of the upward trend in public investment from 3.7% in 2019 to 4.2% in 2020, private investment suffered considerably in the context of the COVID-19 crisis. Overall, gross fixed capital formation declined by 3.1% in 2020. Investment is expected to increase as the country recovers, in part driven by increasing public investment. With

⁷ <https://ec.europa.eu/eurostat/web/european-pillar-of-social-rights/indicators/social-scoreboard-indicators>

consumption possibilities returning after the lifting of containment measures, savings are forecast to return broadly to their pre-crisis level.

Compared with the Commission 2021 Spring Forecast, the macroeconomic scenario underpinning the recovery and resilience plan is based on slightly more cautious macroeconomic assumptions. The macroeconomic scenario underpinning the Stability Programme is realistic in 2021 and cautious in 2022. It projects GDP growth of 3.0% in 2021 and 2.6% in 2022, compared to the Commission 2021 Spring Forecast projections of 3.4% and 4.1%, respectively⁸. The German Stability Programme anticipates a quicker recovery in private consumption, but less vigorous export growth in 2021 (BMF, 2021). For 2022, the Commission forecast is driven by a delayed but strong rebound in consumption. Projections in the Stability Programme assume a return to the pre-crisis level of output in the course of 2022, while employment and private consumption are expected to take somewhat longer to recover. Real GDP in 2022 is expected to exceed its 2019 level by 2.3% according to the Commission forecast and by 0.5% according to the Stability Programme. The Commission spring 2021 forecast projects higher HICP inflation of 2.4% in 2021, falling to 1.4% in 2022.

2.2 Challenges related to sustainable growth, resilience, and cohesion

While the German economy performed strongly in recent years and has cushioned the country relatively well from the economic fallout of the COVID-19 crisis, a number of challenges and structural obstacles have manifested themselves. Germany experienced a decade of economic upswing driven by strong manufacturing and export growth and very favourable developments on the labour market. However, even before the crisis, structural challenges and external headwinds became apparent, some of which have been exacerbated by shifts accelerated by the pandemic.

Productivity growth is expected to remain low, and Germany is at risk of falling behind in its innovation capacity. Total factor productivity growth is forecast to be around 0.8% over the next 5 years, with potential growth of just 1.2% by 2025, according to the 2021 Spring Forecast. Labour productivity growth was lagging behind compared to the USA, especially in information and communication services, professional, scientific and technical activities, and in administrative and support services, in both the decade before (1997-2007) and following the Global Financial Crisis (2007-2017). While Germany remains innovative, it risks falling behind in some cutting-edge technologies, and there is room for improving technology diffusion (see Section 3.2.2). The National Productivity Board also sees the need to invest more in digital infrastructure, teach key digital skills, improve the transfer of knowledge and technology, and use procurement to stimulate innovation (GCEE, 2020). Lack of qualified personnel is a major factor hampering investment in innovation and digitalisation, in particular for SMEs and limiting investments by high-growth businesses (Benedetti-Fasil et al., 2021). SMEs remain slow

⁸ The cut-off date of the Spring forecast of the European Commission was 30 April 2021.

adopters of digital technologies, also compared to other EU Member States. Removing barriers to firm dynamics and making it easier to reallocate resources to more productive businesses could help close the productivity gap in business services with the USA (European Commission, 2021b).

Although research and development (R&D) spending is high and on an upward trajectory, private R&D investment is concentrated in large firms and has stagnated in SMEs over the past decade. Total R&D spending has increased in recent years, from 2.5% of GDP in 2007 to 3.2% in 2019 (third highest in the EU) and is expected to increase further to reach the national target of 3.5% by 2025, as outlined in Germany's high-tech strategy. At the same time, private investment in R&D is increasingly concentrated in large firms, while SMEs continue to invest relatively little. Therefore, measures such as the central innovation programme for SMEs (*Zentrales Innovationsprogramm Mittelstand*), which gives substantial support to companies to increase their innovation capacity and competitiveness, can strengthen innovation activities and support economic recovery. With the exception of R&D, investment intensities for all other intangible assets in Germany were lagging behind the EU-15 average between 2014-2017 (European Commission, 2021b).

Barriers to private and public investment and lack of competition, especially in the service sector, are obstacles to growth. Public investment, especially at municipal level, is hampered by several bottlenecks, including personnel and financing constraints and high regulatory burden, which also affect private investment. These barriers also hamper decarbonisation and the deployment of clean, efficient and integrated energy systems. The digital transformation of the public administration is lagging behind, and reforms to increase transparency and reduce red tape have had limited effect. For start-ups and young businesses, financing is constrained due to underdeveloped venture capital markets, especially for growth and later-stage financing. On liberalising regulated professions, a country-specific recommendation has been issued each year between 2011 and 2019, but hardly any measurable progress has been made.

While the labour market was fairly well shielded during the COVID-19 crisis, taxes on labour remain high, and demographic change and housing affordability continue to pose challenges. Job shedding was limited in 2020, with an employment decline of 1.1%, and unemployment increase only to 3.8%. Taxes on labour remain high, while the potential to raise tax revenue from sources more supportive of inclusive and sustainable growth, such as environmental or wealth-related taxes, remains underused. In the medium term, the retirement of baby boomers (born between 1946 and 1964) will substantially increase age-related spending, while comprehensive measures to improve the pension system are still pending. There is still considerable potential for reducing disincentives that keep second earners from increasing hours worked. Demographic change is affecting rural areas and urban centres very differently – areas with strong population growth face a shortage of affordable housing, while areas with shrinking populations struggle to maintain public services and infrastructure, requiring further action to address regional and territorial disparities and promote cohesion.

Although the health system provides high-quality care, it suffers from shortages of skilled personnel and low levels of digitalisation, which hampers coordination in the health system

and overall efficiency. The health system provides a high level of service and good access to care, which has also helped the country respond to the COVID-19 pandemic. At the same time, staff shortages are a challenge: in autumn 2019, 76% of hospitals already reported difficulties in filling vacancies for physicians and 78.8% of hospitals had longer-term vacancies for nurses; the crisis has put even more pressure on these professions. Even though eHealth infrastructure is being deployed more rapidly, the use of online health and care services, e-prescriptions and medical data exchange remain well below the EU average. More digitalised health services could reduce the gap between urban and rural areas, improve the integration of care, facilitate coordination between various healthcare providers as well as with public health authorities and improve pandemic preparedness, surveillance and management.

The COVID-19 pandemic has aggravated challenges in ensuring equality of opportunity, while structural changes reveal a pronounced need for upskilling. The crisis exacerbated the situation of those who were already disadvantaged, including households with multiple children. The sudden shift to distance learning highlighted the challenges faced by socio-economically disadvantaged pupils, such as lack of access to digital solutions as well as learning space and support at home. The difficulties of adaptation highlighted the importance of further action to digitally transform the education and training systems. Persistent inequalities in basic skills, linked to socio-economic and migrant backgrounds, need to be addressed, also to alleviate existing labour shortages. Further expanding high-quality, full-time early childhood education and care and all-day schools would contribute both to improved student outcomes and improved labour market participation of women. In addition, the most likely uneven recovery across sectors and locations combined with the accelerated digital transition and structural transformation might cause post-pandemic shifts on the labour market, which might ultimately result in net job losses. Higher expenditure on education and skills and more future-oriented reskilling and upskilling would benefit workers directly affected by structural change, be conducive to equal opportunities, strengthen social cohesion and make the future labour force more productive.

2.3 Challenges related to the green and digital transition

Germany needs to step up policy action to achieve carbon neutrality in time and to reap the benefits of the digital transition. An overarching objective of the Recovery and Resilience Facility is to support the twin (green and digital) transition, an aspect where Germany has considerable room for improvement. Relying on the Commission's assessment of Germany's 2020 National Energy and Climate Plan, the Environmental Implementation Review of 2019 and the 2020 Digital Economy and Society Index (DESI; European Commission, 2020d) as well as recent evidence, this section reviews Germany's progress in achieving targets related to the green and digital transitions.

2.3.1 Green dimension

All recovery and resilience plans must include a minimum spending share of 37% related to the green dimension. The measures in the plan should contribute to achieving the EU 2050 climate neutrality objective, and the 2030 energy and climate targets entailed in the National

Energy and Climate Plans. They should also contribute to meeting environmental targets for waste, water, pollution control, sustainable mobility, biodiversity protection and restoration, marine and water resources, and support the transition to sustainable food systems as well as to a circular economy as appropriate, while ensuring that nobody is left behind. Agriculture, forestry and rural areas are key for sustainable food systems and the provision of eco-system services and their needs and potential will need to be adequately taken into account in the green transition.

Germany is stepping up climate protection-related policies and public investment beyond the recovery and resilience plan. The June 2020 stimulus programme allocated EUR 26.2 billion to the Energy and Climate Fund, a special reserve based on revenues from the auctioning of EU Emissions Trading System (EU ETS) allowances for implementing the government's energy and climate policies. In 2020, the Federal Government issued 'green' securities for the first time, reflecting efforts to screen the environmental aspects of budgeting and strengthening the country's position in sustainable finance.

Greenhouse gas emissions

The latest policies and measures set out in Germany's climate action plan and its climate law help close the gap to its binding 2030 target, but it remains to be seen whether this will suffice. Germany's target for non-EU-ETS greenhouse gas (GHG) emissions is a 38% reduction compared to 2005 (to be reviewed in light of the 'fit for 55' action). Germany projects that it will almost close the gap to achieve the 2030 Effort Sharing Regulation target, from 14% gap (based on existing measures) to 3%. To reach the target, it started using carbon pricing in transport and heating⁹, but it is expected that the planned carbon price schedule will have to be increased and be complemented with other measures, including support measures and further incentives to deliver the necessary emission reductions¹⁰ (UBA, 2020a). The exit from coal is planned to be completed by 2038 at the latest, which comes later than similar measures in other countries (Agora Energiewende and Sandbag, 2020). The compatibility of this date with the objective of climate neutrality by 2050 (and 2045 to which the target is expected to be advanced) will also depend on the development of CO₂ prices (which may make coal-fired power generation commercially unviable much earlier than 2038). The socio-economic consequences in coal regions can be mitigated with measures supported by the Just Transition Fund. Germany has also set a quantitative target for further emission reductions in the building sector and has announced several measures on the chemical sector's product use and fluorinated gases ('F-gases'). After the date of submission of its plan and following a constitutional court decision (BVerfG, 2021) that

⁹ Germany has started implementing its national law to introduce carbon pricing for CO₂ emissions from fossil fuel combustion outside the EU ETS as of January 2021. It covers key emitting sectors such as industrial and building heating and transport. The system started with a fixed price and will steadily increase until 2025 (from EUR 25 to EUR 55/t CO₂). The emission cap for 2026 reflects the emission reduction trajectory of the Effort Sharing Regulation. From that year on, allowances will be tradeable.

¹⁰ Germany has a trajectory for emission reductions in the transport sector (125 Mt CO₂eq by 2030 compared to 161 Mt CO₂eq by 2021), responsible for more than a third of the effort sharing emissions.

found the current climate law in breach of the principle of intertemporal freedom, Germany's government proposed a thorough strengthening the climate law, increasing overall GHG reduction by 2030 from currently 55% to 65% and intending to achieve climate neutrality already by 2045.

Sustainable mobility

Higher and faster investment in sustainable transport infrastructure is needed to make progress on emission reductions. Despite some mitigation measures, and against the general downward trend in GHG emissions, transport emissions in 2019 were higher than in 1990. The same is true for final energy consumption in the transport sector. Germany's weak track record in reducing transport emissions, also responsible for its continued failure to meet air quality targets (European Commission, 2019a), calls for greater attention and the possibility of further reviewing price signals. This includes areas such as road charging, placing a stronger emphasis on sustainable multimodal urban mobility while also considering the needs of rural areas, and extending public transport for both passengers and freight. Incentives to boost competition and digitalisation in the rail sector regarding both passenger and freight services should also be reviewed. In the longer run, efforts could also target not only cars, vans, and buses, but also support clean heavy-duty vehicles and sustainable aviation fuels, and also focus on disincentives created by the current taxation system.

Renewable share

Current policies are not ambitious enough to increase the share of renewables to 30% of gross final energy consumption by 2030. Although a set of sectoral targets and policies have been defined, they seem jointly inadequate for reaching targets on renewables, especially on electricity, heating, and cooling¹¹:

- **In the electricity sector, to reach the aim of covering 65% of electricity consumption from renewable energy sources by 2030, further efforts are needed.** While the 40.8% country's share of renewables in electricity consumption is high relative to 34.2% in the EU-28 (2019), progress in deploying renewables has been slow in recent years, with the current trend pointing to a 55% share of renewables by 2030 (Agora Energiewende, Wattsight, 2020). Reaching the 65% target would require efforts in installing further renewable capacities, also in light of the envisaged increase in overall electricity demand due to the expected increased electrification in transport and heating on the one hand and the production of hydrogen from renewable electricity on the other hand. It remains to be seen whether and to what extent recent legislative changes will be sufficient to tackle problems of permitting and repowering onshore wind projects. Grid expansion, which is needed to connect renewable generation sites with regions with high electricity demand, has experienced some delays. Progress is also crucial for the uptake of renewable

¹¹ Germany's share of renewable energy was 17.4% in 2019, 0.6 percentage points below its 2020 target.

hydrogen¹², where Germany plays a key role in the development of planned Important Projects of Common European Interest (IPCEI). Furthermore, the regulatory pricing of electricity is increasingly perceived as hampering decarbonisation.

- **For heating and cooling, the targeted doubling of the share of renewables from 14.6% in 2019 to 27% by 2030 will require further measures.** The key policies and measures in the heating and cooling sector could involve financial incentives: setting a CO₂ price, providing support to replace oil boilers, several (financial and advisory) support measures for households and bigger buildings, and support for renewable heat production plants to build new heat networks and transform existing ones. To reach the target, further efforts may be needed, including increasing the number of buildings with heat pumps.
- **For transport, planned measures appear sufficient to reach the 27% targeted share of renewable energy in 2030¹³.** First-generation biofuels are set to rise to 5.3% of energy consumption in transport and advanced biofuels to 3.5% in 2030. On top of the key policies and measures set out in the plan, Germany is putting in place financial incentives (purchase support, tax incentives) to boost the market uptake of electric, gas, plug-in hybrid, and fuel cell vehicles. Overall, these policies and measures are considered sufficient to achieve Germany's target for renewables in the transport sector.

Energy efficiency

Further measures are needed to deliver on the German national contribution to the already agreed EU energy efficiency targets for 2030. Germany targets a 30% reduction in national primary energy consumption by 2030, compared to 2008. To achieve this, primary energy consumption must fall by an average of 1.5% per year from 2020 onwards. This would represent considerable progress, as prior to 2020, primary energy consumption decreased only by an annual average of 1.1%. To meet the target, in December 2019, the government launched the 'Energy Efficiency Strategy 2050', which includes measures to boost energy efficiency investment across sectors. On buildings, Germany submitted a comprehensive long-term renovation strategy in July 2020. In addition, Germany also developed an ambitious 'Renovate' component in its national recovery and resilience plan, focussed on climate-friendly timber construction, increased energy efficiency of buildings and a higher share of renewable energy for heating and cooling in buildings, which can contribute to accelerating energy efficient buildings renovation. It is estimated that following an average annual renovation rate of 2.6% at the cost optimal level, the primary energy saving potential in Germany, by 2050, is 352 TWh. Over the period of 2021-2050 this is expected to generate more than 12.8 million of full time equivalent jobs (Zangheri et al., 2020). Finally, carbon pricing policies can create additional incentives for energy efficiency measures.

¹² See COM(2020) 301 final for a terminology of hydrogen

¹³ According to the calculations set out by the recast Renewable Energy Directive, including several multipliers.

Circular economy and biodiversity

Biodiversity preservation, waste reduction and the circular economy should also be supported through both regulatory measures and financial incentives. Germany's waste generation at municipal level has remained stable over the last 5 years and remains above the EU average (European Commission, 2019a). In addition, with a secondary material use rate of 16.6%, circularity only meets a small share of the demand for materials at present. Biodiversity loss could be better prevented by a better integration of biodiversity objectives in other policies and increased funding. Despite local successes, 90% of grassland habitats have a less than favourable conservation status which gives cause for concern. Less than 10% of surface water bodies show good status. Out of 35 features of 11 descriptors, only 2 partly and 2 fully reached the status of good environmental status for marine waters by 2020.

Table 2. Overview of Germany's climate objectives, targets and contributions

	National targets and contributions	Latest available data	2020	2030	Assessment of 2030 ambition level
	Binding target for greenhouse gas emissions compared to 2005 under the Effort Sharing Regulation (%)	-8	-14	-38	As in ESR
	National target/contribution for renewable energy: share of energy from renewable sources in gross final consumption of energy (%)	17.4 (2019)	18%	30	Adequate (30% is the result of RES formula)
	National contribution for energy efficiency:				
	Primary energy consumption (Mtoe)	292.1 (2019)	276.6	216	Sufficient
	Final energy consumption (Mtoe)	215.5 (2019)	194.3	185	Modest
	Level of electricity interconnectivity (%)	11.4%	11.4%	Not provided	N/A

Note: Reflecting Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action.

Source: Assessment of the final national energy and climate plan of Germany, SWD (2020) 904; Eurostat where latest available data is indicated for specific years.

2.3.2 Digital dimension

The recovery and resilience plan should include a minimum level of 20% of spending related to the digital dimension. The measures in the plan should, among others, contribute to the digital transformation of the economic and social sector (including public administration, public services, and the justice and health systems). The objective of the measures in the plan should be to not only improve competitiveness, but also resilience, agility, and security of companies and public actors, all while ensuring inclusiveness and preventing the widening of the digital divide across regions and territories. They should also contribute to achieving the Sustainable Development Goals (SDGs), the objectives of which have been integrated into the European Semester since 2020, reinforcing a strong commitment towards sustainability in the coordination of economic and employment policies in the EU.

Compared to the overall strength of the German economy, digitalisation is a relative weakness. Germany ranked 12th in the Digital Economy and Society Index (DESI) (European Commission, 2020d). While it performs reasonably well in most DESI dimensions and has made

progress in addressing some key challenges, there is still room for improvement, in particular in digital public services and the integration of digital technology by companies. The government made significant efforts to present digital transformation strategies and allocate funding to several aspects of the digital transformation. While the regularly updated strategy ‘Shaping Digitalisation’ and the recently established Dashboard¹⁴ provide the direction, a national digital transformation strategy is missing, and coordination in the government is sometimes ad hoc.

Germany leads in 5G readiness in Europe and has made significant progress in fast broadband coverage, but still faces regional and territorial gaps. Germany is the first EU Member State having fully assigned the spectrum of the identified pioneer bands to 5G purposes. There is also progress in other areas: as of mid-2020, 55.9% of households had access to broadband speeds of at least 1 Gbps, an increase of more than 21 percentage points over a year. However, an urban-rural digital divide still persists, and very high-speed fibre coverage (13.8% as of mid-2020) is increasing only slowly. To tackle the digital divide between regions, the government launched a federal funding programme for broadband expansion. The objective is to provide nationwide full gigabit network coverage by 2025, which can only be realised if bottlenecks in planning capacities and shortages of skilled workers are tackled.

There is considerable potential for improving the digital skills of the population, especially when it comes to ICT specialists and those in education. Although the proportion of ICT specialists in the total workforce at 4.9% is higher than the EU average of 4.3%, numbers are insufficient to meet demand, and the shortage of ICT professionals has worsened during the pandemic. Germany also shows deficiencies in the use of digital technologies in schools (only 9% of primary and 48% of secondary schools are highly equipped). On the positive side, there are improvements and currently almost three out of four (72%) schools in Germany have access to high-speed broadband services capable of delivering 100 Mbps or more, while gigabit speeds are available for more than a third of schools (BMVI, 2020, p. 8). Digital skills of teachers are less developed, with only 20% having used it daily in class before COVID-19. Teachers lack digital devices and do not receive sufficient initial training and continued development (European Commission, 2020c). This amplified the disruptive impact of the pandemic on educational progress, in particular for disadvantaged students. Several recent measures focus on digital education, but in some cases (*Digitalpakt Schule*) take-up seems to have been limited by complexity and administrative burden. Although Germany maintains high basic digital and software skill levels across the population, further improving digital skills would allow it to increase the uptake and productivity of teleworking in the long term. Whilst a significant fraction of employees is in occupations that can be carried out from home (38.6% in Germany, 37% in the EU), just 9.6% (11% in the EU) had ever worked from home before the COVID-19 outbreak (Sostero et al., 2020; Milasi et al., 2020).

¹⁴ <https://www.digital-made-in.de>

Germany aims to strengthen its digital innovation potential and promote advanced technologies by investing in knowledge-based capital. The adoption of newer and more advanced ICTs is crucial for data-driven innovation and higher productivity. However, German businesses lag behind in the adoption of advanced ICT tools, including cloud computing (20% versus 26% in the EU, *Eurostat, Community survey on ICT usage and eCommerce in Enterprises*). Although the number of firms that use big data analysis is increasing slightly, there is still a need to boost the collection, sharing and use of data by businesses. With the GAIA-X project, the government aims to establish key building blocks for a European data infrastructure. Other measures include the commitment to create a national supercomputing infrastructure via the European Joint Undertaking ‘EuroHPC’, the important role Germany plays in helping develop proposals for planned IPCEIs on microprocessors and semiconductor technologies as well as on Next Generation Cloud Infrastructure and Services, and the adoption of strategies and related measures on artificial intelligence (AI) and blockchain.

Although several initiatives boost digital investments in SMEs, the pace of digital transformation may still fall short. The COVID-19 crisis has increased the need for digital competences among SMEs where the lack of qualified personnel with the relevant skills is one of the main barriers for their digitalisation process (Leifels, 2021). SMEs face significant hurdles in digitalisation, with 34% of them not having digital competences. It is therefore crucial that Germany further accelerates, focuses and strengthens its initiatives to support SMEs’ digital transformation. The largest funding programme, *Digital Jetzt*, provides around EUR 50 million annually until the end of 2023, which might prove too limited to accelerate the digital transformation of over 2 million eligible firms (OECD, 2020). The latest ‘SMB Digital Maturity Study 2020’ indicates that German SMEs are using the COVID-19 crisis to invest in digitalisation. However, concerns about the digital gap between large firms and SMEs persist.

The public sector is moving towards more digital services and open data, but implementation is slow. There has been relatively slow progress on online interactions between public authorities and the general public. Germany is underperforming other EU countries in terms of penetration of e-government services and digitisation of government services (European Commission, 2020b). Digital public services for businesses are at the same time above EU average. For individuals, one of the main obstacles hampering the use of public services is the low usability of Germany’s eID solution (national identity card). Germany has only recently announced steps to move to a mobile solution and could achieve this by building on similar efforts at European level. Overall, the reasons for slow progress in the digitisation of public services include the limited supply, the lack of user- and mobile-friendliness, and mistrust (OECD, 2020). In addition to the adoption of the Online Access Act (*Onlinezugangsgesetz*) in August 2017, two programmes have been launched to coordinate the Federal and the *Länder* level. By April 2021, 315 of the 575 online services planned by the end of 2022 had been put online. However, the recently published national dashboard for digital government¹⁵ paints too

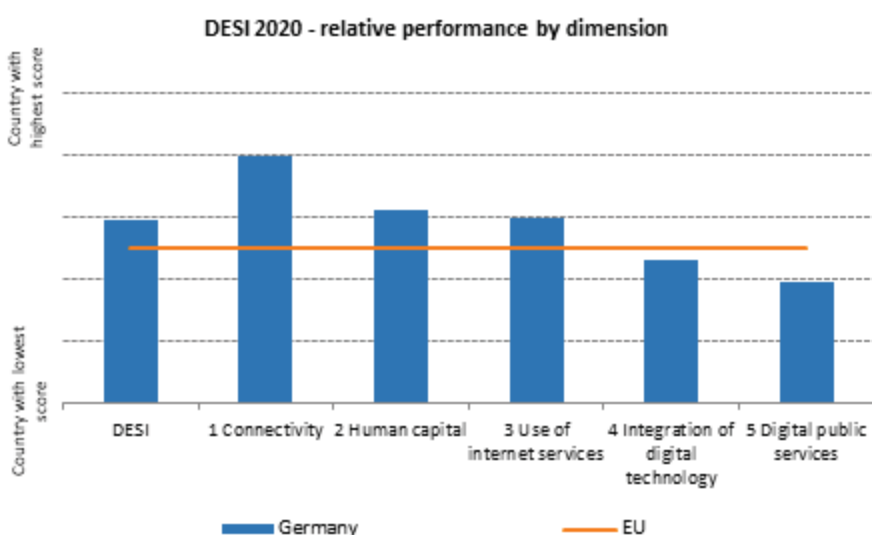
¹⁵ <https://www.onlinezugangsgesetz.de/Webs/OZG/DE/umsetzung/dashboard>

rosy a picture, as it counts a public service as ‘online’ if it is offered by at least one municipality. As many of the services have to be implemented by all 16 *Länder*, the main challenge is to organise an effective legal and organisational framework and strengthen the federal IT coordination body. Cloud adoption remains low in the public sector and could be improved by making use of the European Cloud initiative.

There is further potential for digitalisation to accelerate the green and carbon-neutral transition. Germany should continue its efforts to increase energy efficiency in networks and use more energy-efficient devices, in line with the ‘energy efficiency first’ principle reflected also in Germany’s national energy and climate plan. In addition, the development and use of energy-efficient IT or the reuse of heat from IT (e.g. data centres) in homes and industry could be improved. At the same time, ICT-enabled solutions can reduce energy use considerably – this includes boosting energy efficiency and environment-friendly power generation and storage. The Digital Policy Agenda for the Environment (BMU, 2020) addresses the green digital transition through 70 measures. The momentum from COVID-19 could be used to boost energy transition, the circular economy and sustainable mobility (UBA, 2020b).

Digitalisation can also support the further integration of renewables in electricity production. While Germany’s aim for a high share of renewables (see Section 2.3.1) is welcome, the deployment of variable renewable electricity requires an increasingly integrated energy system, more precise market signals, and enhanced flexibility and demand response. In addition to investments in additional electricity networks, the country can improve the situation by deploying, among others, smart grid solutions – combining investments in electric car charging infrastructure and in energy-efficient buildings with a digital communication layer that allows data access and data sharing.

Figure 1. DESI 2020 - relative performance of Germany by dimension



Note: EU aggregate corresponds to EU28, based on 2020 DESI report - *Digital Economy and Society Index 2020* (European Commission, 2020d).

Box 1: Progress towards the Sustainable Development Goals (SDGs)

The objectives of the Sustainable Development Goals are integrated in the European Semester since the 2020 cycle. This provides a strong commitment towards sustainability in coordination of economic and employment policies in the EU. In that respect, this section outlines Germany's performance with respect to SDGs with particular relevance for the four dimensions underpinning the 2021 Annual Sustainable Growth Strategy and of relevance to the recovery and resilience plans (green transition, fairness, digital transition and productivity, and macroeconomic stability), indicating possible areas where investments and reforms in line with the objectives of the Facility could further accelerate the progress on the SDGs.

Figure : SDGs and key dimensions of the recovery and resilience plan

In this figure, the United Nations' Sustainable Development Goals are represented under a specific Commission guiding principle for competitive sustainability from the 2021 Annual Sustainable Growth Strategy, to which they are strongly associated. It should be noted that most Sustainable Development Goals contribute, to varying degrees, to several guiding principles.



Green transition

Germany has the capacity to be at the forefront of climate and environmental protection. However, despite recent initiatives, meeting its climate and environmental targets requires additional efforts, and its record in green SDGs is somewhat mixed (see also Section 2.3.1). Final energy consumption remains high and is declining slowly; energy import dependency is high. Even though improvements have been made, the greenhouse gas emission intensity of energy consumption remains significantly above the EU-27 average, suggesting improvement potential on SDG 7 ‘Affordable and clean energy’ and SDG 13 ‘Climate action’. Persistently high ammonia and nitrate levels together with a lower-than-average share of organic farming (7.8% in Germany, 8.5% in the EU-27 in 2019) suggest the need for further greening of agriculture and enabling farmers and forester to embark on this transition. Given that the country is already the second largest global supplier of environmental technology, it has the potential to become a lead market and lead supplier (UBA, 2019).

Fairness

There has been considerable progress in most fairness-related SDGs, in particular on poverty (SDG 1 ‘No poverty’), well-being (SDG 3 ‘Good health and well-being’) and decent work (SDG 8 ‘Decent work and economic growth’). The employment rate of 80.6% (age group 20-64) in 2019 was one of the highest in the EU. While 20.6% of the population was at risk of poverty or social exclusion in 2014, this fell to 18.7% in 2018 and even further to 17.4% in 2019. There were clear improvements in avoidable mortality, work and traffic accidents, and exposure to particulate matter. At the same time, the gender pay gap remains high, even though it has been declining; it was 19.2% in Germany vs 14.1% in the EU-27 in 2019. Challenges persist on SDG 4 ‘Quality education’, where post-secondary educational attainment and participation in adult learning remain below the EU average and the share of early leavers from education and training even increased from 9.5% in 2014 to 10.3% in 2019, while it fell from 11.1% to 10.2% in the EU-27. Foreign born are about 2.5 times more likely to drop out compared to native born. On SDG 10 ‘Reduced inequalities’, there remain persistent and relatively high gaps between German nationals and non-EU citizens. Moreover, even if poverty statistics suggest improvements in recent years, the COVID-19 crisis is expected to have increased vulnerability. School closures and the switch to digital learning are also expected to have greatly affected vulnerable students, with only limited cushion provided.

Digital transition and productivity

Germany has high R&D spending that is on an upward trajectory, a relatively high and increasing share of the population working in science and technology as well as in R&D, and a high number of patent applications. These factors underpin good performance on SDG 9 ‘Industry, innovation and infrastructure’. At the same time, investments have been lagging – accelerated investments in digital infrastructure would support the economic recovery and help reduce Germany’s gap with other countries in the coverage of very high-capacity networks. While basic digital and software skills are widespread, specific and advanced digital skills are weaker, with clear shortages in the ICT specialist workforce.

Macroeconomic stability

The German economy has performed very well in recent years, reflected in good outcomes for SDG 8 ‘Decent work and economic growth’. It can rely on strong institutions, reflected in its high score for SDG 16 ‘Peace, Justice and strong institutions’. However, it faces structural challenges, and the booming economy coincided with a persistent current account surplus, reflecting subdued investment compared to savings. While Germany performed very well on employment, certain disadvantaged groups (including people with a migrant background) could be better integrated in the labour market. The proportion of women working part-time remains among the highest in Europe, driven partly by disincentives that hold them back from working more hours.

3. OBJECTIVES, STRUCTURE AND GOVERNANCE OF THE PLAN

3.1. Overall strategy of the plan

The German recovery and resilience plan is a forceful response to the economic repercussions from the COVID-19 pandemic and consists mainly of future-oriented measures, with a strong focus on the green transition and digital transformation. It is composed of 10 components grouped in six thematic focus areas¹⁶: 1 Climate action and energy transition, 2 Digitalisation of the economy and infrastructure, 3 Digitalisation of education, 4 Strengthening social inclusion, 5 strengthening a pandemic-resilient health system, 6 Modern public administration and reducing barriers to investment.

The plan’s first focus area, *Climate action and energy transition*, is devoted to the green transition. With a total estimated cost of approximately EUR 11.3 billion, it represents about 40% of the gross costs of the recovery and resilience plan and implements climate-related policy measures in areas such as energy transition and adaptation to climate change (see also Section 2.3.1 for related policy challenges). The plan envisages a broad range of measures that are grouped under three components:

- Component 1.1 Decarbonisation using renewable hydrogen in particular focuses on supporting the development of hydrogen as a fuel (research, production) to mitigate climate change, notably with Hydrogen projects within the framework of planned Important Projects of Common European Interest (IPCEIs – 1.1.1).
- Component 1.2 Climate-friendly mobility focuses on the green transition in the transport sector. The largest measures under this component are the support for the replacement of the private vehicle fleet with zero- or low-emission vehicles (1.2.3) and for the construction of charging infrastructure (1.2.1), and the support for purchases of buses

¹⁶ These six thematic focus areas, around which the German Recovery and Resilience Plan is structured, are distinct from the six pillars of ‘policy areas of European relevance’ referred to in Article 3 of the Recovery and Resilience Facility Regulation.

with alternative propulsion (1.2.5). These schemes are meant to lower the private acquisition and operating costs of electric vehicles and speed up the transition to low-emission mobility.

- Component 1.3 Climate-friendly renovation and construction is devoted to energy efficiency renovation of buildings. With an associated cost of EUR 2.5 billion¹⁷, Building renovation: federal funding for energy-efficient buildings (1.3.3) represents a broad energy-efficient building renovation programme which is designed to deliver average primary energy efficiency savings of at least 30%. It is complemented by Municipal living labs for the energy transition (1.3.2), which will explore the use of new solutions for efficient and sustainable energy supply in urban neighbourhoods through pilot projects.

The second focus area covers the *Digitalisation of the economy and infrastructure* and consists of two components, which together comprise around 21% of the plan's estimated gross costs.

- Component 2.1 Data as the raw material of the future contains two planned IPCEIs, on Microelectronics and communication technologies (2.1.2), as well as on Next Generation Cloud Infrastructure and Services (2.1.3). The component also contains a measure to implement parts of Germany's data strategy, which encompasses a large number of subprojects, such as bolstering Germany's high-performance-computing capacity, increasing data skills and fostering the sharing and use of data by scientists, as well as by the federal administration services.
- Component 2.2 Digitalisation of the economy includes measures to support the digital transformation in the automotive sector, to develop continuing education and training networks, to strengthen the research and innovation on digital technologies through support to projects run by the centre for digitalisation and technology research of the Bundeswehr, as well as to contribute to the acceleration the digitalisation of the rail sector (as part of a plan already launched at national level).

The third focus area is centred on the *Digitalisation of education* and includes expenditure on digital support for teachers, learning material and digital skills across the education and training sector, including in the armed forces. The focus area consists of a single component, which amounts to around 5.1% of the overall estimated gross cost of the plan.

- Component 3.1 Digitalisation of education includes four measures that have the potential to reach large parts of the education sector. It provides support to equip all teachers across Germany with digital devices for end users (3.1.1) and, within the largest measure of the component, EUR 620 million are provided to set up a single digital platform that

¹⁷ When referring to the cost of the measures in the text, the gross cost is quoted. In some cases this may include VAT. For calculating the climate and digital quota, the net cost, excluding VAT, is relevant. The Annex provides information on net-of-VAT costs for measures relevant for the climate and digital tagging.

will give access to education materials for all levels of institutional and autonomous teaching and learning (3.1.2). Scientific content is developed for Educational centres of excellence (3.1.3), supporting teachers with their digital skills and with digital learning content. The digital readiness of the education sites of the armed forces also gets support (3.1.4).

The fourth focus area covers *Strengthening social inclusion, with expenditure in early childhood education and care, reducing learning gaps in schooling and in apprenticeships, as well as a labour tax related reform*. The focus area consists of a single component that amounts to around 5% of the plan's estimated gross cost, while also including measures for which no RRF funding has been requested.

- Component 4.1 Strengthening social inclusion includes two measures with considerable impact: Apprenticeship support (4.1.3) provides vital support for apprenticeship contracts during the pandemic-related shock, and the Investment programme 'Childcare-financing 2020/21': special fund 'Child Day-care Expansion' (4.1.1) contributes to 90 000 new childcare places. A smaller measure creates a pension information portal. In addition, without asking for funding, Germany commits to putting a temporary ceiling to social security contributions at 40% in the Social Guarantee 2021 (4.1.2) and to Educational support for students with a learning backlog (4.1.4).

The fifth focus area is titled *Strengthening a pandemic-resilient healthcare system, which consists mainly of digitalisation investments for the health sector and a measure for vaccine research*. The focus area consists of a single component with the same title and has an estimated cost of approximately 16% of the overall estimated gross cost of the plan.

- Component 5.1 Strengthening a pandemic-resilient health system has as its largest measure EUR 3 billion dedicated to a scheme to digitalise hospitals (5.1.2), which have in recent years not been able to invest sufficiently in their modernisation. Another measure focuses on the digitalisation of public health authorities (5.1.1), whose lack of digitalisation and insufficient interoperability across the federal states were revealed during the pandemic. A special programme to accelerate research and development of urgently needed vaccines against SARS-CoV-2 (5.1.3), which started in 2020, supports three vaccine producers.

The sixth focus area, *Modern administration and reducing barriers to investment*, consists mainly of digitalisation investments for the public administration and reforms to accelerate public investment. The focus area consists of two components, with a total estimated cost of approximately EUR 3.6 billion, which represents about 12.9% of the total estimated gross cost of the plan.

- Component 6.1 Modern public administration aims to accelerate Germany's efforts to digitalise its public administration, an area in which the country has fallen behind in recent years. The largest investment of the focus area, with EUR 3 billion, is dedicated to making public services digitally available, in line with implementing the German Online

Access Act (6.1.2). The two other measures in this component are the European identity ecosystem (6.1.1) and the modernisation of public registers (6.1.3).

- **Component 6.2 Reducing barriers to investment** contains mostly reforms and does not include costs under the recovery and resilience plan, apart from a EUR 50 million measure for projects with the public sector consultancy *PD - Berater der öffentlichen Hand GmbH* (6.2.2). Several reforms to reduce investment bottlenecks have been implemented already, others are to be developed by a working group comprised of the Federal Government and the *Länder* (6.2.1).

Table 3. The plan's components and their cost¹⁸

Component	Costs (EUR million)
1.1. Decarbonisation using renewable hydrogen in particular	3 259.3
1.2. Climate-friendly mobility	5 427.9
1.3. Climate-friendly renovation and construction	2 577.0
2.1. Data as the raw material of the future	2 766.0
2.2. Digitalisation of the economy	3 136.5
3.1. Digitalisation of education	1 435.0
4.1. Strengthening social inclusion	1 259.3
5.1. Strengthening a pandemic-resilient healthcare system	4 563.9
6.1. Modern public administration	3 475.0
6.2. Reducing barriers to investment	50.0

3.2. Implementation aspects of the plan

The plan is aligned with key European and national programmes and initiatives. The recovery and resilience plan ensures consistency, and leverages the synergies, with:

- the National Energy and Climate Plan and the National Hydrogen Strategy, as explained in detail in Sections 4.1 and 4.5,
- the German Sustainability Strategy for the plan's focus area 1 Climate policy and energy transition and to implement the United Nations' Agenda 2030 and strengthen the national sustainability policy as part of the Decade of Action (2020-2030) (see Sections 2.3.1, 4.4 and 4.5),
- the National Data Strategy, for the plan's focus area 2 Digitalisation of the economy and infrastructure (see Sections 4.1 and 4.6),

¹⁸ The table shows gross cost of the measures. It is understood that at least around EUR 18.98 billion of the total volume of approximately EUR 27.95 billion of the recovery and resilience plan is exempt from value-added tax (see part 6-3 of resilience and recovery plan). Taking away the full amount of potential VAT for the remaining measures (assuming that the maximum VAT rate of 19% fully applies) yields a total budget of at least EUR 26 518.8 million.

- the Youth Guarantee along with a National Skills Strategy, with multiple measures to improve apprenticeships and fight school drop-out by filling education gaps, as part of the plan's focus areas 3 Digitalisation of education and 4 Strengthening social inclusion (see Section 4.1).

Furthermore, Germany puts the reforms and investments from its recovery and resilience plan into the context of the National Reform Programme¹⁹ under the European Semester, as part of the comprehensive agenda of the Federal Government to cushion the impact of the pandemic and respond to the challenges of the future (see Section 4.2).

The reforms and investments in the German plan are consistent with the challenges and priorities identified in the most recent Draft Council Recommendation on the economic policy of the euro area²⁰. Major investments focus on modern emergency capacity and better digital infrastructure for hospitals (EUR 3 billion), supporting digital education (EUR 1.4 billion), increasing social inclusion and thus supporting a fair recovery through the post-pandemic catch-up programme for children and young people (euro area recommendations 1 and 2). The reforms in components 6.1 and 6.2 strive to modernise and digitalise public administration and increase its efficiency and to tackle investment bottlenecks. They are expected to reduce the administrative burden for businesses and citizens and improve the business environment (euro area recommendation 3).

Gender equality issues and equal opportunities for all are adequately addressed. Aspects related to gender equality and challenges related to socio-economic backgrounds run through multiple components. A particularly relevant measure is improving the availability of quality early childhood education and care, which promotes gender equality and the reduction of socio-economic disadvantages, and enables women to return to work earlier after a period of maternity and parental leave and to work more hours. However, with the arrangements regarding joint taxation of spouses, an important disincentive for second earners to work more hours remains in place. Support for apprenticeships and help for students with COVID-19-related learning disadvantages are expected to benefit young people with vulnerable backgrounds over-proportionally, including those with migration background. Recently implemented measures outside of the plan also contribute to equality. For example, in July 2020 the federal government adopted a comprehensive gender equality strategy, while a law enhancing women's representation in company boards (*Zweites Führungspositionen-Gesetz*) is close to being adopted. The legislation process in line with the European Accessibility act to reduce barriers to people with disabilities is in progress²¹. Still, the plan's expected contribution to equal

¹⁹ https://www.bmwi.de/Redaktion/DE/Publikationen/Europa/nationales-reformprogramm-2021.pdf?__blob=publicationFile&v=24

²⁰ Pending final adoption by the Council, after endorsement by the European Council. The text agreed by the Eurogroup on 16 December 2020 is available at: <https://data.consilium.europa.eu/doc/document/ST-14356-2020-INIT/en/pdf>

²¹ <https://www.bmas.de/DE/Service/Gesetze-und-Gesetzesvorhaben/barrierefreiheitsstaerkungsgesetz.html>

opportunities for specific groups, such as older persons and persons with disabilities, could have been described more clearly.

The plan lays down a clear governance structure for its implementation, with a dedicated coordination unit at the Federal Ministry of Finance. The coordination unit (*Koordinierungsstelle*) is also charged with the monitoring of the plan's implementation (see Section 4.8). This includes monitoring and reporting on progress with the implementation of milestones and targets, monitoring the implementation of the audit and control strategy, qualitative control of all financial data and submitting payment requests. The unit is further responsible for identifying and correcting early on any potential undesirable developments. To this end, but also to ensure coherence with the use of other sources of Union funding, the coordination unit is in close contact with the line ministries that are in the lead on the implementation of specific reforms and investments. In its role as coordinator, the Federal Ministry of Finance acts in agreement with the Federal Chancellery, co-penholder of the recovery and resilience plan, and with the Federal Parliament.

Relevant stakeholders were involved in the preparation of the plan and their opinions were considered. Within the scope of their responsibilities, the Federal States (*Länder*) were involved at an early stage and in numerous steps in the elaboration of the recovery and resilience plan through the conferences of Ministers and through the upper chamber of Parliament, the Bundesrat, and their positions were considered in the final elaboration of the plan. The lower chamber of Parliament, the Bundestag, was regularly informed about the status of preparation and the content of the plan; questions of Members of Parliament were addressed. Social partners, social stakeholders, environmental organisations, youth organisations, industry representatives and the national productivity board were all involved in the preparation of the plan. Their views were taken into consideration and reflected in the structure of the plan. The views of the social partners were particularly reflected in the elaboration of the measures in component 4.1 Strengthening social inclusion and the continuing education and training networks (2.2.2) in component 2.2 Digitalisation of the economy. The critical evaluation by environmental organisations of some measures in the draft plan led to the exclusion of investments that were deemed problematic regarding climate protection. Germany worked closely with other Member States on the institutional and technical aspects of the cross-border projects included in the plan. It will be important to involve stakeholders also during the implementation of the plan, in particular for promoting and monitoring SME participation.

An ongoing process of coordination with the Länder is planned also for the implementation phase. In the federal context, the *Länder* will be crucial players in the implementation of the plan, in particular regarding investments in the digitalisation of education and healthcare, apprenticeship support and reforms and investments to modernise public administration and to reduce barriers to investment. Close technical cooperation and coordination between the *Länder* and the federal Ministries responsible for these measures is indispensable to take appropriate account of regional structures during the implementation phase and is provided for in the plan through regular coordination meetings, as requested by the *Länder*, organised by the coordination unit. The *Länder* are expected to be involved closely and in a timely manner in the reporting on the implementation progress.

A comprehensive three-pillar communication strategy is set out in the plan to promote it both to the public and to key stakeholders. The communication on the plan highlights its role for the modernisation of Germany's economy and society in the context of post-pandemic recovery. The strategy is based on integrated communication (first pillar) with a cross-medial (second pillar) and multi-perspective (third pillar) approach. It is coordinated by the Federal Press Office, which develops the visuals, the key messages, and the horizontal narrative on the plan, to be included in the communication material prepared by the responsible federal ministries. The communication involves a mix of formats – text, visual and audio-visual content combined with live events – to be used both by the communication channels of federal ministries and subordinated public bodies and in overarching communication campaigns. The website of the Federal Ministry of Finance serves as a hub that ensures continuous and complete overview of the information on the plan. The third communication pillar establishes a close link between the recovery and resilience plan and the communication activities of the federal government on modernisation projects and plan-related aspects of the national fiscal stimulus package. Key visible landmark events such as the approval of the plan by Council, the launch of key programmes, and reviews of implementation progress are expected to be used as communication opportunities to generate and sustain public and media interest throughout the lifecycle of the plan.

The plan has a strong cross-border dimension. Central elements of the German recovery and resilience plan are the planned IPCEIs in the areas of hydrogen (EUR 1.5 billion), microelectronics (EUR 1.5 billion) and cloud and data processing (EUR 0.75 billion) open for participation to all interested Member States. Other measures such as the one on the European identity ecosystem (6.1.2) are also centred on cross-border cooperation and interoperability.

The recovery and resilience plan does not include a security self-assessment for investments in digital capacities and connectivity. However, related concerns are alleviated by the fact that there is no measure that would relate to 5G deployment, and open strategic autonomy and security issues have been addressed in the description of the component for which they were most relevant, i.e. in component 2.1 Data as the raw material of the future.

State aid and competition rules fully apply to the measures funded by the Recovery and Resilience Facility. Union funds channelled through the authorities of Member States, like the RRF funds, become State resources and can constitute State aid if all the other criteria of Article 107(1) TFEU are met. When this is the case and State aid is present, these measures must be notified and approved by the Commission before Member States can grant the aid, unless those measures are covered by an existing aid scheme or comply with the applicable conditions of a block exemption regulation, in particular the General Block Exemption Regulation (GBER) declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 TFEU²². When State aid is present and it requires notification, it is the duty of the

²² Commission Regulation 651/2014, OJ L 187, 26.6.2014, p. 1

Member State to notify State aid measures to the Commission before granting them, in compliance with Article 108(3) TFEU. In this respect, the State aid analysis carried out by Germany in the recovery and resilience plan cannot be deemed a State aid notification. In as far as Germany considers that a specific measure contained in the recovery and resilience plan entails de minimis aid or aid exempted from the notification requirement, it is the responsibility of Germany to ensure full compliance with the applicable rules. In addition to complying with EU State aid rules, measures taken under this framework should be compatible with the EU's international obligations, in particular under World Trade Organization rules.

4. SUMMARY OF THE ASSESSMENT OF THE PLAN

4.1. Comprehensive and adequately balanced response to the economic and social situation

The plan follows a holistic approach to recovery and reinforcing socio-economic resilience. This is achieved through 40 measures that tackle key structural challenges and pave the way for the twin transition. The measures are organised in 10 components structured around six focus areas: 1 Climate policy and energy transition, 2 Digitalisation of the economy and infrastructure, 3 Digitalisation of education, 4 Strengthening social inclusion, 5 Strengthening a pandemic-resilient healthcare system, and 6 Modern public administration and reducing barriers to investment. Germany submitted its National Reform Programme on 13 April 2021. The information provided in the National Reform Programme is being considered and jointly assessed in this Staff Working Document together with the Recovery and Resilience Plan.

Both the green and digital targets are met, with the digital one exceeded considerably. Overall, the plan is balanced across the six pillars of the RRF Regulation²³ (see Table 4), is aligned with the European Pillar of Social Rights (see also Box 3) and focuses on a significant subset of Germany's main challenges, which beside the twin transition include addressing investment bottlenecks and modernising the public administration.

First RRF pillar: green transition

The plan has a strong focus on the green transition. With a total envelope of approximately EUR 10.5 billion, measures devoted to the green transition represent at least 42.4% of the financial contribution. Measures in the plan are aligned with the German Climate Action Plan 2050 and in many instances also explicitly with the German National Energy and Climate Plan (NECP) for 2021-2030. The German NECP aims to achieve the goals of energy transition and decarbonisation, including the objectives of a reduction in GHG emissions of 38% (compared to 2005), an increase in energy efficiency of 30% (reduction in primary energy consumption), and

²³ Article 3 of Regulation (EU) 2021/241

the reinforcement of the share of renewable sources in energy generation (30% of renewable energy in gross final energy consumption).

Table 4: Coverage of the six pillars of the Facility by the German recovery and resilience plan components

Components	Green transition	Digital transition	Smart, sustainable & inclusive growth	Social and territorial cohesion	Health, and economic, social and institutional resilience	Policies for the next generation
1.1. Decarbonisation using renewable hydrogen in particular	●		●		○	
1.2. Climate-friendly mobility	●		●			
1.3. Climate-friendly renovation and construction	●		○	○		
2.1. Data as the raw material of the future	○	●	●		○	
2.2. Digitalisation of the economy	○	●	○	○	○	○
3.1. Digitalisation of education		●	●	●	○	●
4.1. Strengthening social inclusion		○	○	●		●
5.1. Strengthening a pandemic-resilient healthcare system		●	●	○	●	
6.1. Modern public administration		●	○	○	●	
6.2. Reducing barriers to investment	○	○	○	●	○	○

Key: '●' investments and reforms of the component significantly contribute to the pillar;
'○' the component partially contributes to the pillar.

The plan envisages a broad range of climate-related policy measures in areas such as energy transition and mobility adaptation to climate change. These can be grouped in three main areas of action.

The main actions targeting decarbonisation and energy transition in the economy foster the development of an efficient hydrogen economy, with a particular focus on renewable hydrogen. The plan contains a bundle of measures addressing various stages of the hydrogen value chain from production to use and from research to industrial application. With a cost of EUR 1.5 billion, the hydrogen projects within the framework of planned Important Projects of

Common European Interest (IPCEIs – 1.1.1²⁴) aim to accelerate the necessary market uptake of hydrogen by supporting integrated projects along the entire value chain. This is complemented by further efforts to support flagship projects for research and innovation in the context of the National Hydrogen Strategy (1.1.5), a pilot scheme for climate action contracts based on the principle of carbon contracts for difference (1.1.3) and a support programme for decarbonisation in industry going beyond hydrogen (1.1.2). Efforts are also made to foster the use of hydrogen in the transport sector where electrification is difficult, both for bus purchases (1.2.5) and for funding research and the creation of a Technology and Innovation Centre for Fuel Cell Technology (1.2.7).

A sizeable effort is made to accelerate investments in climate-friendly mobility to address Germany's challenges regarding sustainable transport. The biggest measure under this objective establishes an innovation premium to promote the sale of electric vehicles (1.1.2) which will support battery-electric vehicles. This effort is complemented by support for the construction of charging infrastructure (1.2.1). The promotion of the purchase of alternative-powered buses, i.e. electric buses and hydrogen-powered buses (1.2.5), also represents an important contribution. These more sizable measures are complemented by smaller measures such as the extension of the initial registration period for granting the ten-year tax exemption for purely electric vehicles (1.2.4), the above-mentioned funding of hydrogen and fuel cell applications for the vehicle and supplier industry, and the creation of a Technology and Innovation Centre for Fuel Cell Technology (1.2.7).

Lastly, the plan steps up climate-friendly construction and renovation, with a prominent focus on energy efficiency renovation. The measure Building renovation: Federal funding for energy-efficient buildings (1.3.3) represents a broad energy efficiency building renovation programme, in continuity with existing measures (Castellazzi et al., 2019; European Commission, 2021c), which is expected to deliver primary energy efficiency savings of at least 30%. It is complemented by the funding of Municipal living labs for the energy transition (1.3.2), which will explore the use of new solutions for efficient and sustainable energy supply in urban neighbourhoods through pilot projects. In addition, Germany plans to introduce administrative simplifications, which is expected to facilitate the construction and renovation of buildings and help keep housing affordable (6.2.1).

Beyond climate change mitigation, these measures contribute also to other objectives of the green transition. The measures contribute directly to climate change mitigation, and indirectly to objectives such as environmental protection, including circular economy. For example, all projects in measure Building renovation: federal funding for energy-efficient buildings (1.3.3) will have to comply with circularity principles (recycling of construction waste, and recyclability

²⁴ Measures are identified by a three-number code. The first two numbers indicate the component they belong to and the third number identifies the measure within that component. For allowing quick referencing, measures are referred to with their three-number code. All measures in the plan are listed in the Annex.

and reparability of equipment). Other measures linked to the digital transition such as the planned Important Project of Common European Interest on Next Generation Cloud Infrastructure and Services (2.1.3) and some parts of the programme for vehicle manufacturers and suppliers (2.2.1) contribute to carbon emission reduction but also to energy efficiency. The plan does not contain any measure which has biodiversity as its objective. However, some of the measures for climate mitigation may indirectly benefit biodiversity, given that climate change in itself is an important threat to biodiversity. This is for instance the case for measures supporting the decarbonisation of industry or projects on research and innovation in the context of the National Hydrogen Strategy. Also, Germany has carried out a systematic do-no-significant-harm assessment indicating that none of the proposed measures under the plan generates significant harm to biodiversity.

Based on the methodology for climate tracking set out in Annex VI to Regulation (EU) 2021/241, the quantitative assessment of the plan in relation to the climate target finds a contribution of at least 42.4% of the total allocation, thereby complying with the minimum threshold of 37%, with a direct contribution from 5 of the 10 components.

Second RRF pillar: digital transformation

The recovery and resilience plan puts a strong emphasis on the digital transition and the challenges resulting from it across all sectors. This is reflected both in the share of digital in the overall envelope and the prominence of digital aspects across the components. With a total envelope of approximately EUR 13.5 billion, measures devoted to the digital transition represent at least 52.6% of the financial contribution.

The strong focus on digital is particularly welcome as Germany is a medium performer in digitalisation. In 2020, Germany ranked 12th amongst EU Member States in the Digital Economy and Society Index (DESI), with performances below EU average on the integration of digital technology by enterprises and digital public services (European Commission, 2020a). These two aspects, especially the latter, are well addressed in the proposed recovery and resilience plan.

More than one-fourth of the plan's budget is dedicated to the digitalisation of public services. Key contributions come from component 6.1 Modern public administration, with measures on implementing the European identity ecosystem (6.1.1), the Online Access Act (6.1.2) and the modernisation of public registers (6.1.3). The plan also includes measures to simplify the access to information about pension rights for citizens (4.1.5) and to overhaul data policy that are expected to contribute to improving the use and management of data in the public administration (2.1.1). Digitalisation is also an essential aspect of the measures to modernise the German health system, reflected in upgrading and connecting all public health offices and linking them with other key institutions for public health surveillance (5.1.1) and in the

programme for future-proof hospitals to substantially increase their digital maturity (5.1.2). Furthermore, digitalisation of railway signalling devices is also included (2.2.4)²⁵.

Efforts to digitalise businesses focus on the automotive industry. More than half of the budget for component 2.2 Digitalisation of the economy is earmarked to help the automotive sector address the challenges of the digital transformation, both through investments in research and development and cluster-building (2.2.1).

The measures to improve digital infrastructure and skills are expected to contribute significantly to digitalisation. Various measures promote the digitalisation of education. Teachers will be equipped with digital devices (3.1.1), an education platform will be set up to help learners all over the life cycle (3.1.2), educational centres of excellence will equip teachers with necessary digital skills (3.1.3) and the Bundeswehr's educational and training facilities will be modernised (3.1.4). Digital skills in the workplace will be also promoted by supporting continuing education and training networks (2.2.2), supporting companies that offer apprenticeships (4.1.3), and training staff to use the digital tools supplied in the framework of the future-proof hospitals programme (5.1.2).

Key advanced technologies are an important enabler of a successful digital transformation. A comprehensive set of actions is planned to promote an innovative data policy (2.1.1), including an action on high-performance computing, a pilot measure on data cooperation on sustainability, ecosystem services in the food value chain, and measures for strengthening data literacy in the society and in the federal public administration. Data-driven innovation will be fostered, including through contributions to two multi-country projects for which IPCEIs are planned, on advanced technologies in the areas of microelectronics (2.1.2) and next generation cloud, edge and data processing (2.1.3). This innovation effort will be complemented by funding research and development projects carried out by the Centre for Digitalisation and Technology Research of the Federal Armed Forces (*Zentrum für Digitalisierungs- und Technologieforschung der Bundeswehr*; dttec.bw; 2.2.3) in areas such as cybersecurity, artificial intelligence, robotics, innovative mobility, and the digitalisation of energy.

Third RRF pillar: smart, sustainable and inclusive growth, including economic cohesion, jobs, productivity, competitiveness, research, development and innovation, and a well-functioning internal market with strong SMEs

The plan is expected to contribute significantly to the various objectives of the third RRF pillar. The green and sustainable growth dimension is well covered by the plan (for a detailed discussion see Sections 4.4 and 4.5), and the same holds for digital aspects of smart growth and competitiveness and innovation (see Section 4.6). Given the wide scope of the third RRF pillar, the below list is not exhaustive.

²⁵ <https://www.digitale-schiene-deutschland.de/en>

The plan is expected to contribute to economic cohesion, jobs and social fairness, productivity and competitiveness through a number of measures. The green and digital transitions facilitated by the plan have the potential to create and secure jobs, make the economy more competitive, and contribute to economic and social cohesion. For instance, positioning Germany as an important player in renewable hydrogen also has the potential to create new jobs in this emerging sector. Component 4.1 Strengthening social inclusion is fully devoted to inclusive growth, thereby directly contributing to the third RRF pillar, including through maintaining job creation and by putting a temporary cap on social security contributions (4.1.2). Various measures contribute to upgrading skills and thus addressing labour shortages and enhancing productivity; both through individual learning on an Education platform (3.1.2), as well as through improving the operation of the education system by enhancing availability of digital devices (3.1.1) and improving teaching competences and methodology (3.1.3).

Numerous measures in the plan are expected to contribute to research, development and innovation. These include the innovative IPCEIs planned on hydrogen (1.1.1), microelectronics (2.1.2) and next generation cloud, edge and data processing (2.1.3), as well as measures with a dedicated research focus. Among the latter are, for instance, support for vaccine research (5.1.3), innovation premiums on electro-mobility (1.2.3), setting up a technology and innovation centre for hydrogen (1.2.7), and project-based research on climate change (1.1.4). Research and development are also supported by new low carbon integrated energy systems for urban neighbourhoods (1.3.2) and by developing and implementing greenhouse gas neutral production services (1.1.2)

The well-functioning of the internal market and the role of strong SMEs is given particular consideration. Some measures, in particular those that include a call for projects, positively factor in the involvement of SMEs. The role of SMEs is explicitly considered, for instance, in measures 1.2.5, 1.2.7, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1 and 2.2.2. Other measures are expected to benefit SMEs in particular. It is for instance the case for the implementation of the Online Access Act (6.1.2) and the modernisation of registers (6.1.3), which are set to reduce the administrative burden for all companies and constitute a noticeable improvement especially for SMEs. By providing training and guidance on new business models, new technologies, digitalisation and sustainability, SMEs will be supported also in the timber construction sector (1.3.1). The objectives of continuing education and training networks (2.2.2) include supporting SMEs in particular. It will be important to promote and to monitor SME participation also throughout the implementation phase, including by designing the projects and application procedures with a particular focus on SMEs and with a minimum bureaucratic burden.

Fourth RRF pillar: social and territorial cohesion

The plan is expected to contribute to social and territorial cohesion. A number of measures relate to areas in which also European structural funds promote cohesion, while ensuring that double funding is avoided. Key areas for social cohesion include apprenticeships (4.1.3), the education platform (3.1.2), the educational centres of excellence (3.1.3), creating additional childcare places (4.1.1) and development of continuing education and training networks (2.2.2). Areas relevant for territorial cohesion include the development of the climate-friendly timber

construction sector (1.3.1), municipal laboratories for the energy transition (1.3.2), energy-efficient building renovation (1.3.3) and electromobility with hydrogen technology.

Social cohesion is advanced by a range of educational measures, with a more limited contribution from social measures. Many measures in components 3.1 Digitalisation of education and 4.1 Strengthening social inclusion promote education and skills, also by tackling specific disadvantages (see also the sixth pillar). Capping social security contributions (4.1.2) helps low-wage workers keep their income and jobs, as for them labour demand is more elastic to prices.

Less developed areas can benefit from the deployment of a decentralised renewable hydrogen production and energy-efficient renovation. This is particularly the case for energy-efficient building renovation (1.3.3), which is likely to benefit less developed areas over-proportionally, as those areas tend to have a larger building stock in need of energy-efficient renovation. Also, the digitalisation and connection of all public health services (5.1.1) as well as of hospitals (5.1.2) is expected to support the effective provision of such health services across the country and has the potential to reduce regional differences.

Tackling investment bottlenecks is expected to help areas with infrastructural challenges. Efforts to accelerate planning procedures (6.2.1 and 6.2.3) and to help municipalities manage investment subsidies and digitalise schools (6.2.2) are expected to help municipalities reduce their investment gap, regardless of whether they are representing densely populated areas that need to cope with population inflows or remote, depopulating areas.

Fifth RRF pillar: health and economic, social and institutional resilience, with the aim of increasing crisis preparedness and crisis response capacity, among others

The plan contains substantial investment to bolster the healthcare system's resilience, mainly through measures in component 5.1 Strengthening a pandemic-resilient healthcare system. The pandemic revealed the drawbacks of the heterogeneous landscape of often not interoperable IT systems used by the health authorities. The measures included in the plan aim at creating an interoperable digital infrastructure to connect the public health authorities and other actors in the public health system and are embedded in a more comprehensive strategy to modernise the public health offices (5.1.1). A measure dedicated to vaccine research against SARS-CoV-2 also contributes to Germany's resilience to the current and potential future pandemics (5.1.3). The digitalisation of hospitals, addressed in a large measure in the plan (EUR 3 billion), is expected also to contribute to the overall resilience of the healthcare system and remedy an investment shortfall in the digitalisation of hospitals in recent years (5.1.2).

Social resilience is reinforced through making education more digital. The COVID-19-related switch to remote education was particularly disruptive to the non-digitalised German education system, with shortages or lack of digital equipment and expertise. Component 3.1 Digitalisation of education tackles this vulnerability by providing digital equipment to teachers (3.1.1), better supporting them with digital teaching methodologies (3.1.3) and improving access to online learning materials through a dedicated platform (3.1.2).

The resilience of Germany's public administration is increased by digitalisation and modernisation measures. Component 6.1 is expected to improve citizens' access to digital public services and develop a European digital identification ecosystem. By reducing the need for in-person interactions in the provision of public services, these measures contribute to a public administration that is more resilient to disruptions than one using the current analogue workflows.

Sixth RRF pillar: policies for the next generation, children, and young people, such as education and skills

The plan has a strong focus on acquiring skills, starting from nursery age. High quality nurseries and kindergartens can play a key role in mitigating socio-economic disadvantages before entering school. The plan's effort to add 90 000 childcare places (4.1.1), and improve childcare quality is thus an important contribution to equal opportunities.

The plan's measures help avoid the compounding effects of learning disadvantages and early school leaving. Pupils with a learning backlog because of COVID-19 (around 1 million students) will receive an offer for additional tutoring services and other learning support (4.1.4). To avoid a surplus demand for apprenticeship placement due to companies scaling back their apprenticeship programmes, businesses will receive financial support to keep on hiring (4.1.3).

Through an effective use of digital resources, the education system is expected to improve thanks to the plan. Teachers will receive digital equipment such as laptops and tablets (3.1.1) and support in the form of digital teaching methodologies through educational centres of excellence (3.1.3).

Young people are expected to have more opportunities to improve their skills. A one-stop web portal is expected to make educational content more accessible to learners of all ages (3.1.2). The creation of continuing education and training networks (2.2.2) is expected to help companies provide their staff with relevant trainings.

Taking into consideration all reforms and investments planned by Germany, its recovery and resilience plan represents to a large extent a comprehensive and adequately balanced response to the economic and social situation, thereby contributing appropriately to all six pillars referred to in Article 3 of the RRF Regulation, taking the specific challenges and the financial allocation of Germany into account. This would warrant a rating of A under the assessment criterion 2.1 in Annex V to the RRF Regulation.

4.2. Link with country-specific recommendations and the European Semester

Overall, the plan represents a comprehensive and adequate response to the challenges faced by Germany's economy and society. The plan introduces reforms and investments notably in the areas of climate and digital transition, resilience of the healthcare system, modernisation of the public administration, removing investment bottlenecks, promoting social inclusion, education and skills. These constitute a significant subset of the challenges identified in the country-specific recommendations to Germany. Nevertheless, considering the entrenched nature of the challenges, further efforts are needed in the coming years on several reform areas.

This is particularly the case for recommendations in areas such as taxes on labour and the tax wedge, disincentives to work for second earners, competition in business services and regulated professions, and sustainability of the pension system while maintaining adequacy.

The COVID-19 pandemic led to the deepest recession on national record, yet the economic and social impact was cushioned by far-reaching measures to sustain the economy and support the ensuing recovery (CSR 1 in 2020). The economy contracted by 4.8% in 2020, recording an unprecedented -9.7% in the second quarter of 2020. The federal government swiftly made use of its ample fiscal space to support decidedly its economy and society and alleviate the immediate impact of the pandemic. The federal government and *Länder* provided liquidity for companies, subsidising them to keep their skilled workforce, and provided income support for workers including through the short-time work scheme *Kurzarbeit*, from which about 6 million workers benefitted at the peak in April/May 2020. Insolvency rules were modified to avoid technical insolvency procedures. Liquidity support also helped contain risks to financial stability. The government balance deteriorated by 5.7 pps. to a deficit of 4.2% of GDP in 2020, due to the size of public support measures related to the COVID-19 pandemic. Still, the deficit turned out smaller than expected on account of administrative bottlenecks causing delays in the pay-out of support measures accounting for 1% to 2% of GDP. The relevant amounts are expected to be actually paid out in 2021. Despite the considerable stimulus package and the ample guarantees, risks to fiscal sustainability have remained limited so far, thanks to the sound starting position of public finances.

The plan adequately complements Germany's efforts to tackle the health consequences of the crisis. In the immediate response to the pandemic, Germany was able to provide high-quality healthcare and rapidly increase its testing and intensive-care capacity. At the same time, however, the ongoing pandemic underlined the continuous need to strengthen the resilience of the system, including eHealth (CSR1 2020). While Germany benefitted from its universal healthcare system at the peak of the pandemic, the insufficient digitalisation of the healthcare sector and the lack of interoperability of the available IT systems were exposed (for example by the use of fax machines by the public health offices to report new COVID-19 cases). Germany is addressing these challenges in its recovery and resilience plan. It dedicates one of the six focus areas of the plan to strengthening a pandemic-resilient healthcare system, with a strong focus on the digitalisation of public health services and the hospital sector (5.1.1, 5.1.2). With a strong research base, Germany engaged immediately in research and innovation for the development of vaccines and therapeutics against COVID-19. It was a German start-up – BioNTech – that developed the first approved SARS-CoV-2 vaccine in the world. The German plan supports BioNTech and two other vaccine producers with EUR 750 million for vaccine research against SARS-CoV-2 (5.1.3). The investments in the plan aimed at strengthening the healthcare system thus effectively address the country-specific recommendation to mobilise adequate resources and build overall resilience of the health system, including by deploying eHealth services.

The plan effectively addresses investment-related recommendations given to Germany to reduce the gap between savings and investment, reflected also in Germany's high current account surplus. Country-specific recommendations to increase public investment and tackle

bottlenecks to both public and private investment have been repeatedly addressed to Germany since the beginning of the Semester process. In addition, Germany has been identified as experiencing macroeconomic imbalances related to its large current account surplus, which reflects subdued investment relative to saving and has cross-border relevance. The implementation of the reforms included in the plan to reduce barriers to investment and modernise the public administration (Components 6.1 and 6.2) is expected to strengthen the capacity and planning capability of the public administration and improve its efficiency in deploying public investment. It is also expected to reduce red tape for businesses, thus freeing up capacities and improving the business environment to incentivise private investment. The extension of the consulting services of *PD – Berater der öffentlichen Hand GmbH* (6.2.2) to municipalities is expected in particular support investment at the regional and municipal level, where investment needs are the highest (European Commission, 2020a; European Commission, 2019b including its Annex D).

A dedicated component in the recovery and resilience plan deals with the need to invest in sustainable mobility (CSR 1 in 2019). More investment in clean public transport and infrastructure, including in electric mobility and related charging infrastructure, alternative fuels such as hydrogen and e-fuels, and clean mobility solutions are needed to tackle mobility and air quality challenges and to support the green transition of the sector. Greenhouse gas emissions from road transport have increased over the last 5 years. Air quality in Germany also gives cause for concern, especially in urban areas where traffic accounts for about 60% of harmful NOx emissions. These challenges are effectively addressed by component 1.2 Climate-friendly mobility. The investment and reform priorities of this component, such as the development of electro-mobility (1.2.2), the promotion of the industries involved in hydrogen and fuel cell applications in transport (1.2.7), support for the construction of charging infrastructure (1.2.1), the extension of the initial registration period for granting the ten-year tax exemption for purely electric vehicles (1.2.4), are coherent with the identified challenges and previous progress in the country-specific recommendation to focus investment-related economic policy on sustainable transport.

Germany's transformation to a climate-neutral economy also requires sizable investment in clean, efficient and integrated energy systems and network (CSR 1 in 2019 and CSR 2 in 2020); the plan includes measures to promote such investment. Germany's electricity networks are slowly adapting to renewable production and significant investment in transmission and distribution grids remains necessary. Investments in energy networks that promote sector coupling, diversification and an appropriate grid infrastructure are crucial for the flexibility of the energy system and for better integration across different sectors of the economy in view of the achievement of energy and climate targets. Component 6.2 Reducing barriers to investment helps address this challenge. Component 1.1 focuses on the decarbonisation of the economy. Its goal is, among others, to develop an EU-wide integrated market for renewable hydrogen production including cross-border transport infrastructure. To this end, Germany is working together with other Member States in the framework of planned IPCEIs on green hydrogen (1.1.1). With this, the reforms and investments under component 1.1 contribute directly to the design of clean and integrated energy networks.

Housing in large German cities has become less affordable. The plan provides an adequate response to this challenge with investment in energy-efficient renovation (CSR 2 in 2020 and CSR 1 in 2019). House prices have risen by half in the last decade. This development reflects a shortage of housing supply relative to demand, as the completion of new dwellings remains considerably below demand and well below the government target of 375 000 per year. The renovation of existing housing stock by adhering to environmental considerations could reduce energy consumption, make the cost of housing more affordable, in particular for disadvantaged households, and promote the green transition. This is addressed by the energy efficient building renovation measure (1.3.3), which budgets EUR 2.5 billion for investment in the energy-efficient renovation of buildings. Beyond this investment, the plan provides for reforms to remove barriers to investment (component 6.2) and thus strengthens, among others, the capacities for construction works, which is expected to benefit also the supply of social housing and improve transport options from areas where housing is more affordable.

Various investments in the plan aim to expand digital infrastructure and improve digital skills (CSR 1 in 2019 and CSR 2 in 2020). The digitalisation of the German economy is progressing slowly. There is still a significant urban-rural divide in digital infrastructure, so that uncovered regions risk to be left behind, not only when competing for businesses and economic development, but also in various social dimensions – something that the lockdown made more visible. Investments in digital infrastructure can support the economic recovery and help reduce Germany's gap with other countries in the coverage of very high-capacity networks, which remains substantial. While basic digital and software skills are widespread, specific and advanced digital skills are weak and there are clear shortages in the workforce. Facing all these challenges, Germany is putting a strong emphasis on the digitalisation of its economy in its recovery and resilience plan, with more than 50% of the total envelope dedicated to investments in the digital infrastructure, digital education and skills, and more generally to the digital transition of the economy, public administration and society. The completion of the proposed reforms and investments into digital initiatives is expected to contribute significantly to the implementation of the country-specific recommendations to Germany to focus investment-related economic policy on the digital transition, in particular digital infrastructure and skills, even if no measure is proposed in the plan to support the deployment of very high-capacity broadband networks (which is however supported through federal and state programmes that are being implemented, for example the Federal Support Programme for Broadband Expansion, see National Reform Programme 2021).

The plan taps into the large potential for improving digital public services (CSR 2 in 2020). Modern and connected digital services are crucial when mobility is restricted, but Germany still underperforms in these compared to other Member States, even though digital service provision to businesses improved recently. Still, the level of online interaction between the authorities and the public is very low. The implementation of the Online Access Act (6.1.2) should lead to significant improvements in digital public administration. Connected public registers (6.1.3) are then expected to help citizens and businesses reap the full benefits of digitalisation and reduce the administrative burden for them. The introduction of an open and license-free digital European identity ecosystem (6.1.1) is likely to boost the use of digitally available public

services. The register modernisation (6.1.3) is expected to help Germany introduce the once-only principle in digital public services as required across border by the Single Digital Gateway Regulation ((EU) 2018/1724). With this, the measures in the plan would go a long way towards the modernisation and digitalisation of public services.

A set of reforms aims to reduce the regulatory and administrative burden for businesses (CSR 2 in 2020). Keeping the administrative burden for access to support measures at a minimum both during and in the wake of the pandemic speeds up the implementation of these measures and ensures easier access to them for both citizens and businesses. Reducing other administrative burdens more broadly, i.e. beyond support measures, for example by applying flexibility for non-essential bureaucratic procedures, can provide additional relief to SMEs. Component 6.1 Modern public administration is addressing these issues with several reforms of the public administration. These reforms provide for the introduction and eventually for the effective application of the once-only principle through digital means across all levels of the administration. Measures related to the public administration are included also in component 2.1 Data as the raw material for the future. These provide for the use of administrative data across ministries and other public bodies. With this, the plan contributes effectively to reducing administrative burden and compliance costs for businesses.

The German plan gives a strong boost to investment in research and development and innovation (CSR 1 in 2019 and CSR 2 in 2020). While Germany invests considerable resources in research and development (R&D), private investment in R&D is increasingly concentrated in large firms, while SMEs and start-ups face challenges. Total R&D intensity, from both the public and private sectors, has increased in recent years, but this increase does not necessarily translate into a higher innovative performance of the German economy. In particular, SMEs' R&D expenditure stagnated over the past decade and the level of innovation by SMEs decreased in recent years. The plan contains investments in research, development and innovation spread throughout several components. Most prominent examples are the planned IPCEIs in the areas of renewable hydrogen, microelectronics and cloud technology. In addition to these, various measures in components 1.1, 1.2, 2.2, and 5.1 also support R&I. The programme for vehicle manufacturers and suppliers (2.2.1) in particular supports research and development with a focus on SMEs.

The plan includes measures to address the repeated recommendations to reduce disincentives to work more hours, in particular for low-wage and second earners (CSR 2 in 2019). In 2019, Germany had the second lowest average hours worked in the main job, and the share of women working part time due to caring responsibilities was among the highest in the EU. Standing at 56.9% in 2018, Germany's share of revenues from labour taxes and social security contributions on total revenues is the second highest in the EU. The effective marginal burden from taxes and social-security contributions is relatively high for low- and medium-income earners, while the joint taxation of spouses severely limits work incentives for second earners, contributing to a low share of women working full-time. In addition to the joint taxation framework, and despite a strong expansion since 2010, persistent supply gaps remain in the provision of quality full-time childcare. The high labour tax wedge, which includes also social

security contributions, and the insufficient provision of full-time quality childcare thus create significant disincentives for labour demand and supply and pose a risk to a job-rich economic recovery by reducing work incentives and consumption possibilities. This was already partially alleviated by the abolition of the solidarity surcharge for most taxpayers as of 2021. In addition, several measures in component 4.1 Strengthening social inclusion tackle these challenges. Regarding the high tax wedge on low and medium incomes, the Social Guarantee 2021 (4.1.2) provides a temporary relief through a cap on social security contributions up to the end of 2021. This stabilisation reduces disincentives to work more hours at least until the end of 2021. In parallel, investment in new childcare facilities (4.1.1) is expected to have a positive impact on the number of hours worked for parents with caring responsibilities.

Investment in education is a priority of the plan and improving the educational outcomes and skill levels of disadvantaged groups is supported through relevant measures (CSR 2 in 2020, CSR 1 and 2 in 2019). Already before the emergence of the COVID-19 crisis, technological progress was transforming the labour market, requiring increased funding of education and training, including reskilling and upskilling and improving digital skills. The COVID-19 crisis made this need even more pressing. The sudden shift to a more digitalised society and home-based education poses a particular challenge for vulnerable pupils and students who do not have access to digital solutions and support at home. This includes students with disabilities. Already existing inequalities in basic skills, linked to socio-economic and migrant backgrounds, risk to be exacerbated. The plan dedicates a comprehensive set of investments and reforms to digital education, which is also one of the six focus areas of the plan (3 Digitalisation of education), and training (measures 2.2.2 Development of continuing education and training networks and 4.1.3 Apprenticeship support). A special reform programme (4.1.4) is offering educational support for students with a learning backlog due to the pandemic, targeting effectively disadvantaged pupils whose educational possibilities were disproportionately affected by the crisis. A higher number of high-quality early childhood education and care places (4.1.1) is expected to help address educational disadvantages early on. Overall, the plan boosts investment in education, puts forward adequate measures to strengthen educational outcomes and skills, in particular of disadvantaged groups, improves conditions for participation in the labour market, and safeguards employability in the long term.

The plan is expected to partly contribute to the long-term sustainability of the pension system and the adequacy of pensions (CSR 2 in 2019). The retirement of the baby boomer generation is affecting Germany more than other EU countries. In the long run, this demographic change is expected to strain Germany's public finances, putting the long-term sustainability of the pension system and the adequacy of pensions at risk. By 2040, Germany is expected to be facing a relatively high increase in spending on public pensions in relation to GDP (up by 1.7 pps. of GDP from 2019), and at the same time the public pension benefit ratio is expected to fall by 2.8 pps., to 39% (EPC/EC, 2021). The German recovery and resilience plan provides a description of the pension system, including the private pension scheme *Riester Rente*, without binding milestones and targets or specific reforms of the pension system. However, the plan commits to the development of a digital pension portal (4.1.5) which is expected to support

citizens in their pension planning by providing an overview of their individual pension rights from all three pension pillars.

While as of 2021, the fee scale for architects and engineers has been liberalised, and legislative processes are ongoing to liberalise some aspects of tax advice services, the plan does not include further measures to address the country-specific recommendation to strengthen competition in business services and regulated professions (CSR since 2011).

The priorities of the plan are coherent with progress on the relevant country-specific recommendations. As evident from the juxtaposition of the proposed reforms and investments with the most imminent challenges to the German economy and society, the six priorities of the plan focus on the most pressing issues and are expected to contribute significantly and effectively to the resolution of these challenges.

Addressing these challenges could boost Germany's growth potential in a sustainable manner. With a fast-ageing population, potential growth in Germany is on a long-term declining trend. Investment bottlenecks, such as inadequate administrative capacity for public investment and procurement, overly complex procedures, and insufficient planning capacities, have been holding back investment – another driver of potential growth – for years. In addition, the low level of digitalisation and patchy coverage of very high-speed broadband have a negative impact on investment. The reforms in the plan to reduce barriers to investment, together with the relevant investments into the green and digital transitions, have the potential to boost potential growth in the long-term in a sustainable manner, beyond the short time span of the fiscal stimulus.

Taking into consideration the reforms and investments envisaged by Germany, its recovery and resilience plan is expected to contribute to effectively addressing all or a significant subset of challenges identified in the country-specific recommendations, or challenges in other relevant documents officially adopted by the Commission under the European Semester, and the recovery and resilience plan represents an adequate response to the economic and social situation of Germany. This would warrant a rating of A under the assessment criterion 2.2 in Annex V to the RRF Regulation.

Table 5. Mapping of country challenges identified in 2019-20 country-specific recommendations and components in Germany's recovery and resilience plan

Country challenges (as identified in Section 2)	Associated CSR (2019-2020) and European Semester recommendations	Component 1.1 Decarbonisation	Component 1.2 Climate-friendly mobility	Component 1.3 Climate-friendly renovation	Component 2.1 Data as the raw material	Component 2.2 Digitalisation of the economy	Component 3.1 Digitalisation of education	Component 4.1 Social inclusion	Component 5.1 Healthcare system	Component 6.1 Modern public administration	Component 6.2 Barriers to investment
Public finances											
Fiscal policy and fiscal governance	2019.1.1 ; 2020.1.1; 2020.2.2	○	○	○	○	○	○	○	○	○	●
Sustainability and adequacy of pensions	2019.2.4							●			
Labour market, education and social policies											
Disincentives to work, tax burden on labour	2019.1.8; 2019.2.1, 2019.2.2, 2019.2.3							●			
Wages and wage setting	2019.2.5						○	○			
Health and long-term care	2020.1.2								●		
Education, skills, including for disadvantaged groups	2019.1.2, 2019.2.6, 2020.2.5 and 2020.2.7						●	●			○
Investment and structural policies											
Energy systems	2019.1.6; 2020.2.4	●	●	●		○					○
Sustainable transport	2019.1.5; 2020.2.3	●	●								●
Housing	2019.1.7; 2020.2.6			○							○
Digitalisation and digital infrastructure	2019.1.4; 2020.2.5; 2020.2.10				●	●	●		●	●	○
Research and innovation	2019.1.3; 2020.2.8		○		●	○				○	
Competition in business services and regulated professions	2019.1.9										
Public administration and business climate											
Digitalise the public administration	2020.2.9									●	○
Reducing the regulatory and administrative burden	2020.2.11		○			○				●	

Key: “●” investments and reforms of the component significantly address the challenge; “○” the component partially addresses the challenge

4.3. Growth potential, job creation, economic, institutional and social resilience, European Pillar of Social Rights, mitigating the impact of the crisis, and social territorial cohesion and convergence

Fostering economic growth and jobs

The plan aims to accelerate the economic recovery in Germany by implementing investments in physical and human capital and adopting reforms. By improving Germany's growth potential, creating jobs and increasing economic, social and institutional resilience, the measures included in the plan are expected to ultimately reduce the country's vulnerability to shocks. The plan is a resolute contribution to the green and digital transition and gives effect to the EU ambition in these fields. It actively contributes to the implementation of the EU update of the 2020 new industrial strategy²⁶. The three planned IPCEIs on hydrogen, microelectronics, and cloud, edge and data processing are expected to develop and industrially deploy the next generation of green and secure digital capabilities to directly contribute to economic growth, competitiveness and resilience. The plan is also expected to contribute to the implementation of the European Pillar of Social Rights, including through the promotion of policies reducing child poverty and increasing youth employment, and help Germany further in being an inclusive society with good access to health care and a productive and sustainable economy.

The German economy has weathered the COVID-19 crisis relatively well. The economic impact of the COVID-19 pandemic has been less severe than initially expected. The massive drop in GDP in the first half of 2020 was followed by a strong, if incomplete, rebound and the decline for the entire year turned out smaller than during the global financial crisis and smaller than the GDP decline in the rest of the EU on average. Employment in 2020 fell by 1.1%, while the unemployment rate remained among the lowest in the EU, significantly aided by the expanded subsidy short-time work arrangement (*Kurzarbeit*) and other income support measures. Aggregate household disposable income remained stable. An increase in the saving rate was driven by forced rather than precautionary savings. The accumulated savings are expected to give impetus to a recovery in consumption as soon as the public health situation allows it. Contact-intensive sectors, which were disproportionately affected by containment measures, account for a relatively small share of employment in Germany. On the other hand, a large part of the economy, notably industry, was spared from the containment measures and has been recovering vigorously since the second half of 2020. Sentiment has also been improving steadily, indicating an imminent expansion of business investment. Overall, from a macroeconomic point of view, the economy is well set to return to the pre-crisis level of output towards the end of the year. Levels of consumption and employment are expected to rebound to pre-pandemic levels over the next year, as contact-intensive services take somewhat longer to return to their normal volume of activity.

²⁶ See European Commission, Updating the 2020 New Industrial Strategy, COM(2021) 350 final, 05.05.2021

German authorities responded to the economic fallout of the COVID-19 pandemic using established policy tools. Ample fiscal space allowed providing subsidies and financial assistance to firms, which helped avoid a large wave of insolvencies. The overall decline in investment has remained contained. Subsidised short-term work (*Kurzarbeit*) has also prevented large-scale lay-offs and an erosion of firm-specific human capital. Combined with automatic stabilisers built into the tax and social benefits system and with targeted social transfers, the scheme was also effective in cushioning the income loss, including for poorer households. Increased benefits and *Kurzarbeit* together were making up for 80% of the income losses households suffered from COVID-19 (Christl et al., 2021). This way, the immediate impact of the crisis was mitigated using the standard set of policy tools. The measures of the plan, while expected to provide an additional boost to output and employment growth in the short term and speed up the economic recovery, are primarily focused on addressing structural challenges to long-term growth, innovation capacity, and inclusiveness.

Despite being a highly developed, resilient economy offering effective social protection, Germany still faces challenges in ensuring sustainable and more inclusive long-term growth. Policy analysis by international and German institutions as well as the German authorities have identified a need to boost productivity growth, innovation and equality of opportunity and stepping up the green and digital transition. Barriers to public and private investment are still a relevant issue. The country is at risk of falling behind on its innovation capacity and R&D activity, in particular concerning SMEs. Regarding digitalisation, there is significant untapped scope for the further deployment of high-capacity data networks, a stronger integration of digital technologies into the public and private sector, and the dissemination of digital skills. Furthermore, Germany needs to step up its efforts to reach the renewables and energy efficiency targets, in order to achieve carbon-neutrality by 2050 - and even more so as this target is expected to be advanced to 2045 (see Section 2).

The recovery and resilience plan includes measures addressing these challenges in a coherent way and convincingly demonstrates how they could benefit potential growth and job creation. The plan comprises a varied mix of investments and investment support (decarbonisation, climate-friendly mobility and housing, digitalisation), expenditure into human capital (education, healthcare) and reforms of the public administration, including an emphasis on removing barriers to investment. The synergy between more investment in future-oriented technologies (green and digital), higher quality of human capital and better governance is expected to boost productivity growth, including in the long run, and potential output. With the help of a state-of-the-art economic model, similar to the one applied by the Commission, the effects are quantified in a rigorous way to plausibly demonstrate the improvements in output and productivity growth and the increasing demand for labour (job creation) that stem from the measures included in the plan in the medium and long term (Clemens et al, 2021). According to the model simulation results, the level of GDP is expected to be 0.13% higher than the baseline on average for the duration of the plan (2021-2026). The difference in the output level relative to the baseline is expected to ease to around 0.1 pps in 2027 and subsequently weaken further but remain slightly positive. Productivity is expected to be 0.1% higher in 2022-2026 and remain slightly higher than baseline in the long run. Considering also spill-over effects from other

countries, the Commission's QUEST model finds that Germany's GDP can increase by between 0.4% and 0.7% by 2026, and effects could be stronger considering the impact of structural reforms (see Box 2).

Box 2: Stylised NextGenerationEU impact simulations with QUEST - Germany

Model simulations conducted by the Commission using the QUEST model show that the economic impact of the NextGenerationEU (NGEU) in Germany could lead to an increase of GDP of between 0.4% and 0.7% by 2026²⁷. After 20 years, GDP could be 0.2% higher. Spillovers account for a large part of such impact.

According to these simulations, this would translate into up to 135 000 additional jobs. Cross border (GDP) spillovers account for 0.4 pps in 2026, showing the value added of synchronised expenditure across Member States (line 2). Even in a scenario with a lower productivity of NGEU funds, it would still lead to a significant impact (line 3)²⁸.

Table: QUEST simulation results (%-deviation of real GDP level from non-NGEU case, linear disbursement assumption over 6 years)

Scenario	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Baseline	0.5	0.6	0.6	0.6	0.7	0.7	0.6	0.5	0.4	0.4	0.2
<i>of which spillover</i>	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.0
Low productivity	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.2	0.2	0.1

This stylised scenario does not include the possible positive impact of structural reforms, which can be substantial. A model-based benchmarking exercise shows that undertaking structural reforms that would result in halving the gap vis-à-vis best performers in terms of indicators of structural reforms could raise German GDP by 8% in 20 years' time, compared to 11% for the EU average. (Varga and in 't Veld, 2014)

Due to the differences in the assumptions and methodology, **the results of this stylised assessment cannot be directly compared to the numbers reported in chapter 4 of Germany's RRP.**

²⁷ RRF amounts to roughly 90% of NGEU, which also includes ReactEU, Horizon, InvestEU, JTF, Rural Development and RescEU.

²⁸ Technically, the low productivity scenario considers a significantly reduced output elasticity of public capital.

The plan can be understood as additional to the expenditure policy currently in place. The bulk of the response to the economic impact of the pandemic has been realised within the national policy framework, without resorting to EU instruments. The overall volume of the expected disbursements from the RRF to Germany of EUR 25.6 billion is rather small relative to the size of the economy (0.74% of 2019 GDP, spread over six years). Judging from information contained in the 2021 Stability Programme, the level of planned public capital expenditure is set to increase in subsequent years relative to 2020, even without considering the expenditures to be financed by the RRF. Furthermore, for most of the measures, additional funding will also come from national sources.

Strengthening social cohesion

The plan strengthens social cohesion through multiple measures and aims to contribute to the implementation of the principles of the European Pillar of Social Rights. In particular, component 4.1 Strengthening social inclusion contains measures to reduce social vulnerabilities and strengthen social protection systems. For instance, to support parents and increase equality of opportunity, childcare is bolstered by providing financial support to the *Länder* to create additional high-quality childcare capacities (4.1.1). Furthermore, pupils who have fallen behind because of the pandemic will receive additional teaching support (4.1.4). These efforts, targeted at pupils, are complemented by measures in component 3.1 Digitalization of education, some of which is expected to have a positive effect especially on vulnerable groups. To support the apprenticeship system, which has been negatively impacted by the pandemic, companies receive financial incentives to hire and retain apprentices (4.1.3), which hence contribute to fulfilling the Youth Guarantee. With the Social Guarantee 2021 (4.1.2), the plan contributes to preventing a rise in non-wage labour costs, which have remained at a high level in Germany, by capping social security contributions at 40%. The plan also commits to developing a digital pension portal (4.1.5), which aims to support citizens in their pension planning by providing an overview of their individual pension provisions from all three pension pillars.

Germany's relatively good results on the Social Scoreboard are expected to be reinforced by the plan. Germany has been a relatively good performer according to the Social Scoreboard accompanying the European Pillar of Social Rights (see Box 3). Still, some indicators such as early school leaving and persons not in education, employment or training (NEETs) have been deteriorating lately and hence the measures of the recovery and resilience plan mentioned above are particularly welcome.

Reducing vulnerability and increasing resilience

The German plan includes several investments and reforms to increase resilience and reduce vulnerabilities. The pandemic has exacerbated or revealed vulnerabilities, for instance regarding the digital capacities of the public health offices and public administration, which is expected to be bolstered by several measures in the plan. Component 6.2 is fully dedicated to reducing barriers to investment, which can help provide a faster and more forceful economic response to future shocks. Furthermore, the support provided to the German industry to switch to climate-friendly technologies (see measures in components 1.1, 1.2 and 2.2) is expected to help

companies become more resilient to shocks from rising and volatile CO₂ prices. Social resilience is improved through measures to strengthen social inclusion and on education.

Component 6.2 Reducing barriers to investment is expected to increase Germany's capacity to absorb economic shocks, if implemented well. Resistance to shocks is expected to increase as streamlined decision-making processes accelerate the implementation of investment projects. The reforms included in this component cover multiple areas, including the acceleration of planning and approval procedures, which have already been partially implemented in 2020 (6.2.3). Other reforms are to be developed by a working group that brings together the federal and *Länder* levels (6.2.1). These reforms include, for instance, the reinforcement of planning and approval authorities, accelerating the outflow of financial aid, targeted support to municipalities, and streamlining participation procedures through digital methods. Since these reforms can facilitate public and private investment, they can also contribute to narrowing the current account surplus.

Component 6.1 Modern public administration aims to increase the resilience of the public administration by increasing its degree of digitalisation. The contact restrictions and lockdown measures in response to the pandemic have demonstrated the importance of digitalising Germany's public administration, as most public services cannot be accessed online yet. The Online Access Act implementation (6.1.2) aims to make hundreds of public services digitally available by 2022 and is complemented by a measure to modernise registers (6.1.3), and a measure to establish a European ecosystem for online identification (6.1.1). Germany's ambition to implement this last measure on a European scale is a welcome initiative, demonstrating a focus on maintaining interoperability with other Member States.

Component 5.1 Strengthening a pandemic-resilient health system aims to increase the health sector's resilience. Public health offices have been important actors in tackling the pandemic in Germany and have been significantly lagging behind in their digitalisation and in terms of interoperability of data systems across the federal states. Modernising public health offices (5.1.1) aims to address these challenges and contribute to increasing resilience. Furthermore, the overall efficiency gains expected from a large measure to digitalise hospitals (5.1.2) can bolster the healthcare system and emergency capacities. The plan also contains a measure dedicated to vaccine research (5.1.3), which has proven to be a key instrument for overcoming the pandemic and has made the economy and the society more resilient.

Components 3.1 Digitalisation of education and 4.1 Strengthening social inclusion are expected to improve social resilience and adaptability. Improving the operation of the education system by providing digital devices for teachers (3.1.1), making improved teaching methodologies available (3.1.3) and helping availability of digital educational material (3.1.2) is expected to lead to improved performance. These efforts may be particularly successful if coupled with flanking measures caring for the more vulnerable, such as additional support for students with learning backlogs (4.1.4).

Cohesion and convergence

The plan is expected to contribute considerably to social cohesion, while territorial cohesion and convergence is addressed in a rather implicit way. Components 3.1 Digitalisation of education and 4.1 Strengthening social inclusion improve education and skills, particularly aiming to support students with learning gaps (4.1.4). Component 5.1 Strengthening a pandemic-resilient healthcare system is expected to facilitate access to healthcare and thus contribute to social cohesion, also benefitting hospitals (5.1.2) and public health offices (5.1.1) in remoter areas and in challenged urban areas where backlogs are particularly prevalent.

Cross-border projects are expected to contribute to convergence across the EU. Germany, together with France, initiated planned IPCEIs open to all Member States (1.1.1, 2.1.2, 2.1.3). With an allocation of EUR 3.8 billion, the plan gives a considerable impetus for these projects with the aim to create an integrated EU-wide market for hydrogen production including cross-border transport infrastructure, to lay down the foundations for the next generation edge, cloud infrastructure and services, and to improve the EU's standing on selected microelectronic communication technologies.

Box 3: Employment and social challenges in light of the Social Scoreboard accompanying the European Pillar of Social Rights

The Social Scoreboard supporting the European Pillar of Social Rights points to relatively few employment and social challenges in Germany. Due to the COVID-19 pandemic and the measures to contain it, Germany's economy contracted by 4.8% in 2020, after 10 years of expansion. However, the extended regulations on short-time work helped prevent dismissals on a larger scale. The decrease in employment was limited to 1.1% in 2020 while compensation of employees increased by 0.5% after a

3.0% increase the year before. Germany's well developed social protection system and well-established social dialogue also helped mitigate the impact of the COVID-19 pandemic. Although the employment rate among women is one of the highest in the EU and the gender employment gap is below the EU average, Germany has one of the highest part-time employment rates among women, accompanied by a wide gender pay gap (also reflecting differences in the number of hours worked). The rate of early leavers from education and training has not improved since 2016 and is above the EU average.

The insufficient provision of full-time childcare and all-day school facilities contribute to lower labour market attainment among women. The employment rate of women with children younger than 6 is 21.7 pps lower than that of women without children, one of the widest differences in the EU (where the average is 9 pps). Despite ambitious measures to respond to the increasing demand for childcare and provide more places in all-day schools, with 31.4% of children under 3 in formal childcare in 2019, the country remains below the EU average of 35.3% and the Barcelona target of 33%. Ensuring the quality of childcare provision remains essential too.

Poverty has been gradually decreasing in the years before the COVID-19 pandemic.

Social Scoreboard for GERMANY						
Equal opportunities and access to the labour market	Early leavers from education and training (% of population aged 18-24) (2020)					
	Youth NEET (% of total population aged 15-24) (2020)					
	Gender employment gap (2020)					
	Income quintile ratio (S80/S20) (2019)					
	At risk of poverty or social exclusion (in %) (2019)					
Dynamic labour markets and fair working conditions	Employment rate (% population aged 20-64) (2020)					
	Unemployment rate (% population aged 15-74) (2020)					
	Long term unemployment (% population aged 15-74) (2020)					
	GDHI per capita growth (2019)					
	Net earnings of a full-time single worker earning AW (2019)					
Social protection and inclusion	Impact of social transfers (other than pensions) on poverty reduction (2019)					
	Children aged less than 3 years in formal childcare (2019)					
	Self-reported unmet need for medical care (2019)					
	Individuals' level of digital skills (2019)					
Critical situation	To watch	Weak but improving	Good but to monitor	On average	Better than average	Best performers

Update of 29 April 2021. Member States are classified on the Social Scoreboard according to a statistical methodology agreed with the EMCO and SPC Committees. It looks jointly at levels and changes of the indicators in comparison with the respective EU averages and classifies Member States in seven categories. For methodological details, please consult the Joint Employment Report 2021; NEET: neither in employment nor in education and training; GDHI: gross disposable household income.

In 2019, the at risk of poverty or social inclusion rate fell further to 17.4%, well below the EU average of 20.7%. Social transfers are impactful; they reduced the number of people at risk of poverty by over one third (36.2%), which is above the EU average (32.4%). Even though poverty figures suggest improvements in recent years and the tax and transfer system provided support, the COVID-19 pandemic is likely to have increased vulnerabilities.

The recovery and resilience plan submitted by Germany addresses a multitude of employment and

social challenges relevant for the implementation of the Pillar. To foster equal opportunities and access to the labour market and to reduce disincentives to work for second earners, mainly women, Germany is expected to expand quality child day-care facilities (4.1.1). To improve labour market dynamics, skills, and working conditions, a digital education platform (3.1.2) and educational centres of excellence (3.1.3) are put forward, which are expected to improve access to the labour market. Introducing a cap on social security contributions to prevent increases in the labour tax wedge (4.1.2) provides a solution at least for 2021. Finally, the plan fosters resilience of the health system and its accessibility by stepping up its digitalisation.

Taking into consideration all reforms and investments envisaged by Germany, its recovery and resilience plan is expected to have a high impact on strengthening the growth potential, job creation, and economic, social and institutional resilience of the Member State, on contributing to the implementation of the European Pillar of Social Rights, including through the promotion of policies for children and youth, and on mitigating the economic and social impact of the COVID-19 crisis, thereby enhancing the economic, social and territorial cohesion and convergence within the Union. This would warrant a rating of A under the assessment criterion 2.3 of Annex V to the RRF Regulation.

4.4. The principle of ‘do no significant harm’

Germany’s recovery and resilience plan assesses compliance with the ‘do no significant harm’ (DNSH) principle. The assessment follows the methodology set out in the Commission’s Technical guidance on the application of ‘do no significant harm’ under the Recovery and Resilience Facility Regulation (2021/C 58/01). It covers the six environmental objectives within the meaning of Article 17 of Regulation (EU) No 2020/852, namely climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystems. The environmental impact is assessed at measure-level, i.e. one individual assessment per reform or investment.

Each DNSH assessment follows a two-step approach. In step one, the potential risk that a measure could do significant harm to any of the environmental objectives is assessed. When there is no risk of significant harm, the measure assessed complies with the objective of the Regulation. When a risk of significant harm is identified, a more detailed assessment follows in step two, in which Germany must demonstrate the absence of significant harm. Results of the two-step approach are often conflated into one table for conciseness.

A significant part of Germany’s plan is devoted to decarbonisation notably through renewable hydrogen. Component 1.1 and the measure providing support to the vehicle and supply industry for hydrogen and fuel cell applications in transport (1.2.7) are central to this

effort. Electricity generation is not yet a climate-neutral activity, but as set out in the Technical guidance on the application of DNSH under the Recovery and Resilience Facility Regulation²⁹, the deployment of electrification technologies and infrastructure including hydrogen is required for a climate-neutral economy and should be considered to comply with DNSH if a policy framework for electricity decarbonisation and the development of renewables is already in place in the relevant Member State. In that respect, the plan recognises that the demand for (renewable) electricity linked to support for green hydrogen production should not lead to an increase in CO₂ emissions and sets out a related monitoring for the development of the demand for renewable hydrogen. Notably, the plan indicates the efforts to promote the energy transition by promoting renewable energy, which have been operationalised through the Renewable Energy Act (EEG) and other measures.

Germany’ plan also puts a strong emphasis on climate-friendly mobility. Despite the positive decarbonising effect on the transport sector, battery production and recycling may conflict with the circular economy objective. The plan therefore stresses that the measure Support for the replacement of the private vehicle fleet (1.2.3) will comply with the End-of-Life Vehicles Directive³⁰, which specifies that residuals must be used according to the waste hierarchy.

Germany’s recovery and resilience plan puts a particular focus on energy renovation (component 1.3). While such renovation reduces emissions overall, it usually creates significant amounts of construction waste. Germany therefore ensures no significant harm will be done to the circular economy objective by detailing, in the measure on energy-efficient buildings’ renovation (1.3.3), that at least 70% of the non-hazardous construction and demolition waste generated on the construction sites by weight will be prepared for re-use, recycling, and other material recovery.

The plan also includes several regulatory reforms (e.g. components 6.1 and 6.2) and measures related to education (component 3.1) and health (component 5.1). The DNSH assessment indicates that their environmental impacts are negligible and that they are expected to do no significant harm to any of the six environmental objectives. Concerns linked to the circular economy and the acquisition of IT equipment are also covered for instance for the Digital and technical strengthening of the public health service (5.1.1)

Measures whose impact on the environmental objectives necessitate close scrutiny are given special consideration. Under measures 1.1.2 and 1.1.3 support may be provided to installations covered by the EU emissions trading system (ETS). DNSH compliance is ensured by the fact that only projects with emissions substantially below ETS benchmark are eligible for

²⁹ 2021/C 58/01, Commission Notice Technical guidance on the application of ‘do no significant harm’ under the Recovery and Resilience Facility Regulation, 12 February 2021.

³⁰ Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles.

support under the measures. Regarding the support for purchases of buses with alternative propulsion (1.2.5), it is to be noted that the financing of buses to be fueled with biomethane will remain limited. The share of gas buses has steadily decreased in recent years to currently around 2% of all city buses in use. The fuels used by the supported gas buses will comply with the requirements of the Renewable Energy Directive (EU) 2018/2001 (REDII), in particular its Articles 29 to 31 on sustainability and greenhouse gas emission saving criteria and Article 26 on the rules for food and feed based biofuels.

Regarding the vehicle manufacturer/supply industry investment programme (2.2.1), the plan specifies that only future investments that make a significant contribution to the programme's digitalisation and climate objectives will be supported, therefore targeted support for fossil combustion engine technologies in the vehicle sector is excluded under the measure. Regarding the support to promote alternative rail propulsion (1.2.6), hybrid locomotives will only represent a fifth of the measure in costs and will only be financed for shunting in freight transport where no fully electric offers exists. Moreover, hybrid locomotives will only be used where bi-modes locomotives cannot. Under the measure on building renovation, providing federal funding for energy-efficient buildings (1.3.3), gas-fired boilers can also be financed, albeit limited to replacing coal and oil-based heating systems. According to the DNSH assessment the investment is expected to lead to a significant reduction of air emissions and an improvement in public health in areas where the EU air quality standards laid down in Directive 2008/50/EU are or could be exceeded. Also, in line with the Technical guidance on the application of DNSH under the Recovery and Resilience Facility Regulation, the investment in gas condensing boilers is part of a broader building renovation programme to improve energy efficiency in line with the long-term renovation strategies under the Energy Performance of Buildings Directive and leads to a significant improvement in energy performance. Finally, photovoltaic modules will be installed together with the gas boilers during these renovations.

Taking into consideration the assessment of all the measures envisaged, no measure for the implementation of reform and investment projects included in Germany's recovery and resilience plan is expected to do significant harm to environmental objectives within the meaning of Article 17 of Regulation (EU) No 2020/852 (the principle of 'do no significant harm'). This would warrant a rating of A under the assessment criterion 2.4 of Annex V to the RRF Regulation

4.5. Green transition

Germany's plan correctly follows the methodology for climate tracking set out in Annex VI to the RRF Regulation by identifying intervention fields and corresponding coefficients for the calculation of support to the climate objectives, for each measure. It should be noted that:

- the measures of the plan often consist of several sub-measures; for these measures, the plan indicates an intervention field for each sub-measure and computes the climate contribution at sub-measure level;
- the choice of intervention fields for the climate transition is well justified and reflects the nature, focus, objective or expected outcome of the investments; and

- the plan does not propose to increase the climate coefficient for any measure.

Table 6 Climate contribution per component

Component	Total cost	Climate-related	Climate contribution	
	(EUR million)		as % of the cost of the component	as % of the non-repayable allocation
1.1 Decarbonisation using renewable hydrogen in particular	3 138	3 138	100%	12.2%
1.2 Climate-friendly mobility	5 329	4 602	86%	18.0%
1.3 Climate-friendly renovation and construction	2 574	2 523	98%	9.8%
2.1 Data as the raw material of the future	2 684	150	6%	0.6%
2.2 Digitalisation of the economy	3 019	460	15%	1.8%
3.1 Digitalisation of education	1 206	0	0%	0.0%
4.1 Strengthening social inclusion	1 174	0	0%	0.0%
5.1 Strengthening a pandemic-resilient healthcare system	4 434	0	0%	0.0%
6.1 Modern public administration	2 920	0	0%	0.0%
6.2 Reducing barriers to investment	42	0	0%	0.0%
Total (net of VAT)	26 519	10 873	41%	42.4%

Note: The table shows the cost of the components without VAT. For some measures Germany indicated that the gross costs may include VAT, which for this table was deducted assuming that the full VAT rate of 19% applies. This results in a potentially lower estimate for the measure cost without VAT. Reflecting this, the contribution to climate purposes is estimated to be at least 42.4%. For further details, please see the tagging at measure level in Annex 1.

Measures supporting climate change objectives in Germany's recovery and resilience plan account for at least EUR 10 872 502 168 which represents at least 42.4% of the plan's total allocation. Five of the 10 components in the recovery and resilience plan include expenditure that contributes to the climate objectives.

Component 1.1 Decarbonisation using renewable hydrogen in particular provides the largest contribution to the climate mitigation objective. All of the seven measures of the component are fully counted towards the climate target as they all aim to develop green hydrogen. Most measures operate at various stages of hydrogen development (research, production and use) but ultimately aim to mitigate climate change. Other measures aim at developing decarbonisation solutions in general without limitation to hydrogen. With a cost of EUR 1.5 billion, the planned Hydrogen IPCEIs (1.1.1) make the second biggest contribution to climate protection and aims to accelerate the necessary market uptake of hydrogen by supporting integrated projects along the entire value chain. This effort is complemented by supporting flagship projects for research and innovation in the context of the National Hydrogen Strategy (1.1.5) and the development of carbon neutral production processes in hard-to-decarbonise

industrial sectors (1.1.2 and 1.1.4), including a pilot scheme for climate action contracts based on the principle of carbon contracts for difference (1.1.3) and measures more specifically oriented towards SMEs and research (part of 1.1.4).

The second largest contribution to the climate target is provided by component 1.2 Climate-friendly mobility. The biggest contribution under that component results from the support for the replacement of the private vehicle fleet (1.2.3). This effort is complemented by support for the construction of recharging infrastructure for the deployment of a Germany-wide network (1.2.1). The promotion of the purchase of alternative-powered buses and related refuelling or recharging infrastructure (1.2.5) also represents an important contribution to the climate target in that component. These more sizable measures are complemented by smaller ones with a full climate tag such as the extension of the initial registration period for granting the ten-year tax exemption for purely electric vehicles (1.2.4), the funding, for the vehicle and supplier industry, of hydrogen and fuel cell applications, and the creation of a Technology and Innovation Centre for Fuel Cell Technology (1.2.7).

A third important part of the plan's climate contribution comes from component 1.3 Climate-friendly renovation and construction, devoted to energy efficiency renovation. With an associated cost of EUR 2.5 billion, the measure Building renovation: federal funding for energy-efficient buildings (1.3.3) represents the biggest contribution of the plan to the climate target. This is a broad energy-efficient building renovation programme which is expected to deliver energy savings of at least 30% during its implementation under the RRF. It is complemented by municipal living laboratories for the energy transition (1.3.2) which will explore the use of new solutions for efficient and sustainable energy supply in urban neighbourhoods through pilot projects.

Other measures linked to the digital transition also contribute to the plan's climate target (components 2.1 and 2.2). This includes two measures: the planned IPCEI on next generation cloud infrastructure and services (2.1.3) and some parts of programme for vehicle manufacturers and suppliers (2.2.1) which will target carbon emission reductions but also energy efficiency improvements.

Green transition

The implementation of the measures in Germany's recovery and resilience plan is expected to effectively contribute to the green transition and to addressing the challenges associated with this transition. The plan supports the decarbonisation and energy transition objectives of Germany as set out in the National Energy and Climate Plan (NECP). In its NECP, Germany commits to reducing GHG emissions (38% reduction compared to 2005), increasing energy efficiency (30% reduction in primary energy consumption), and increasing renewable energy (30% renewables in gross final energy consumption)³¹. Together with the NECP, the German

³¹ For a comprehensive assessment of the German NECP, see Economidou et al.(2020).

Climate Action Plan 2050 ensures coherence between the energy and climate areas, and the interconnection with the green and energy transition dimension of the investments envisaged in the recovery and resilience plan.

The recovery and resilience plan contributes to the commitments made in the National Energy and Climate Plan and the Roadmap for Carbon Neutrality 2050 across various components:

Component 1.1 Decarbonisation using renewable hydrogen in particular is expected to contribute as a primary goal to the objective of GHG emission reduction as defined in the German NECP with a focus on the industry. Sustainable CO₂-free hydrogen that is produced using renewable energy can play an important role in achieving energy and climate targets and in the decarbonisation of the economy. The plan notably provides that specific integrated projects along the entire hydrogen value-added chain is planned to be promoted within the scope of hydrogen projects within the framework of planned IPCEIs (1.1.1). With a focus on energy-intensive industries, the funding programme for the decarbonisation in industry plans to reduce process-related industrial emissions by supporting research and development, testing in test and pilot facilities and investments in CO₂-reducing facilities (1.1.2). To support the higher operating costs required for innovative decarbonising technologies, the plan also includes a pilot scheme for climate action contracts based on the principle of carbon contracts for difference (1.1.3).

Component 1.2 Climate-friendly mobility is also expected to support Germany in reaching its GHG emission reduction targets, with a focus on the transport sector. Support for the construction of charging infrastructure (1.2.1) as well as sub-measures in 1.2.2, 1.2.5, and 1.2.7 should support the market ramp-up of battery- and hydrogen-based vehicles. The plan is expected to also support the funding for the development of electro-mobility (1.2.2) and the support scheme for e-vehicles (1.2.3) is expected to directly boost demand for these types of passenger cars and close existing gaps in the area of research and development by means of targeted support. This is complemented by a reform of vehicle taxation with a tax exemption for purely electric vehicles (1.2.4) and by promoting the vehicle and supply industry for hydrogen and fuel cell applications in transport (1.2.7). Other measures within this component aim to promote purchases of buses with alternative propulsion (1.2.5) and alternative propulsion in rail transport (1.2.6).

Component 1.3 Climate-friendly renovation and construction is expected to strongly contribute to Germany's contribution to the Union's energy efficiency targets as set in its NECP. This component generally has a strong focus on the EU flagship Renovate. The aim of the measure Building renovation: federal funding for energy-efficient buildings (1.3.3) is to encourage investments that will improve energy efficiency and increase the share of renewable energies in the end energy consumption of buildings. Compared to its predecessor scheme it will step up emission savings thanks to increased support for renewable energy heating systems, smart home solutions, renovations to very high efficiency classes and the abolition of support for lower classes of energy performance. Municipal living labs for the energy transition (1.3.2) is also expected to contribute to these targets by supporting energy-optimised urban district projects (see Schnapp et al. 2020) as blueprints for the roll-out of efficient and integrated energy solutions

to achieve emission reductions in urban districts. The GHG emission reduction potential of those measures is expected to be reinforced by Germany's carbon pricing policy.

These measures contribute to the green transition and to some degree to the protection of the environment, e.g. by promoting circularity in the renovation measure (1.3.3) and by improving air quality standards through the measures in the climate-friendly mobility component (1.2). The plan does not contain any measure directly addressing biodiversity. However, some measures for climate mitigation contained in the plan may also indirectly be beneficial to biodiversity given that climate change is one of the main threats to biodiversity. Germany has carried out a systematic do-no-significant-harm assessment indicating that none of the proposed measures generates harm to the protection and restoration of biodiversity and ecosystems. The recovery and resilience plan supports Germany in meeting the national energy and climate targets set out in its NECP and in the German Climate Action Plan 2050 and thus in achieving carbon neutrality in 2050/2045.

Measures can generally be expected to have a positive long-term impact on environmental objectives. Regarding the funding programme for decarbonisation in industry (1.1.2), calculations by DIW annexed to the plan estimate that the measure will save 562 500 tonnes of CO₂ equivalent per year in the long term, resulting in emission savings of 11.25 million tonnes over an approximate lifetime of 20 years (Clemens et al, 2021). Regarding the funding for the development of electro-mobility (1.2.2), this independent study annexed to the plan concludes that through the investment volume of EUR 75 million allocated to this measure, the plan could support the deployment of around 3 275 electric vehicles and 1 823 recharging points, which 'would result in an approximate emission saving of around 98 250 tonnes of CO₂ assuming an average life span of twelve years'. The same study underlines the long-lasting effect of the municipal living laboratories for the energy transition (1.3.2). A living lab is assumed to save approximately 200 000 tonnes of CO₂ equivalent per year on average. The amount financed under the recovery and resilience plan (EUR 57 million) is therefore expected to prevent approximately 9.12 million tonnes of CO₂ equivalent from being emitted in the long term.

Taking into consideration the assessment of all the measures envisaged, the recovery and resilience plan is expected, to a large extent, to make a significant contribution to the green transition or to address the challenges resulting from it and ensures that at least 37% of its total allocation contribute to the climate target. This would warrant a rating of A under criterion 2.5 of Annex V to the RRF Regulation.

4.6. Digital transition

Digital tagging

To determine the contribution of the proposed measures to the digital transition and the challenges resulting from it, the methodology laid down in Annex VII to the RRF Regulation has been applied.

It should be noted that:

- appropriate intervention fields have been selected for most of the measures;
- for a few measures, for instance the federal programme ‘Building continuing education and training networks’ (2.2.2) and the apprenticeships support (4.1.3), the proposed digital tagging could have been more substantiated (or else, the measure could have been broken down into a digital and a non-digital part);
- the plan does not propose to increase the digital coefficients for any measure.

Overall, based on the methodology, the contribution to digital objectives accounts for more than half of the recovery and resilience plan’s total allocation, which is far above the 20% target set by the Regulation. Out of the ten components of the plan, six include measures directly supporting the digital transition or addressing related challenges. The most important contributions come from components addressing the modernisation of the health system (5.1) and of the public administration (6.1), followed by the two components addressing the digitalisation of the economy (2.2), and data and advanced technologies (2.1) respectively.

Table 7 –Digital contribution per component

Component	Total cost	Digital-related	Digital contribution	
	(EUR million)		as % of the cost of the component	as % of the non-repayable allocation
1.1 Decarbonisation using renewable hydrogen in particular	3 138	0	0%	0.0%
1.2 Climate-friendly mobility	5 329	0	0%	0.0%
1.3 Climate-friendly renovation and construction	2 574	0	0%	0.0%
2.1 Data as the raw material of the future	2 684	2 684	100%	10.5%
2.2 Digitalisation of the economy	3 019	2 664	88%	10.4%
3.1 Digitalisation of education	1 206	1 206	100%	4.7%
4.1 Strengthening social inclusion	1 174	319	27%	1.2%
5.1 Strengthening a pandemic-resilient healthcare system	4 434	3 684	83%	14.4%
6.1 Modern public administration	2 920	2 920	100%	11.4%
6.2 Reducing barriers to investment	42	0	0%	0.0%
Total (net of VAT)	26 519	13 476	51%	52.6%

Note: The table shows the cost of the components without VAT. For some measures Germany indicated that the gross costs may include VAT, which for this table was deducted assuming that the full VAT rate of 19% applies. This results in a potentially lower estimate for the measure cost without VAT. Reflecting this, the contribution to climate purposes is estimated to be at least 52.6%. For further details, please see the tagging at measure level in Annex 1.

Digital transition

With a significant share of the overall budget and a prominence of digital aspects across the majority of its components, the recovery and resilience plan proposed by Germany clearly puts a strong emphasis on the digital transition and the challenges resulting from it across all sectors.

The measures of the plan cover six of the seven priority areas identified in Annex VII to the RRF Regulation:

- digital-related investment in research and development,
- human capital,
- the digitalisation of public services,
- the digitalisation of businesses,
- investments in digital capacities and advanced technologies, and
- the greening of the digital sector.

Connectivity is the only area for which no measure is proposed under the recovery and resilience plan. However, it is to be noted that actions are planned with national funding to address this priority. To tackle the digital divide between regions, the government notably launched a federal funding programme for broadband expansion.

The proposed measures are well aligned with the digital strategy adopted by the federal government in November 2018 (Shaping digitalisation³² – *Digitalisierung gestalten*). This strategy comprises five pillars, which are all addressed by the recovery and resilience plan:

- digital competence,
- infrastructure and equipment,
- innovation and digital transformation,
- society in digital transformation,
- modern State.

The German recovery and resilience plan also tackles the four strategic priorities identified at EU level and reaffirmed in the recent communication on Europe's Digital Decade³³: skills, infrastructures, digital transformation of businesses and digitalisation of public services.

More than half of the effort on digital will be dedicated to the digitalisation of public services, notably through the measures in component 6.1 (Modern public administration). The proposed reforms and investments are expected to help develop and improve the delivery of, and the access to, public administration services. A measure of this component also aims at fostering the development of a European identity ecosystem based on an open and licence-free identity infrastructure and another measure at the introduction of the once-only principle in public administration. Moreover, one measure in component 4.1 (Strengthening social inclusion) will specifically address the simplification of the access to information about pension rights for citizens, while the first measure in component 2.1 (Data as the raw material of the future) is

³² <https://www.bmwi.de/Redaktion/DE/Dossier/digitalisierung.html>

³³ COM(2021) 118 - 2030 Digital Compass: the European way for the Digital Decade, 9 March 2021

expected to contribute to improving the skills and organisational structures for the use and management of data within public administration. All these measures are expected to represent important contributions to addressing policy priorities identified in the eGovernment action plan adopted by the European Commission³⁴ to which Member States committed in the 2017 Tallinn Declaration on eGovernment³⁵ and the more recent Berlin Declaration on Digital Society and Value-based Digital Government³⁶.

Digitalisation is also an essential aspect of the measures envisaged to modernise the German health system. In component 5.1 (Strengthening a pandemic-resilient healthcare system) a substantial amount (EUR 3 billion) will be invested into modernisation projects in hospitals. These projects are expected to help improve quickly the degree of digitalisation of hospitals, covering the whole patient care process in a hospital and taking cybersecurity aspects into account. Another measure will address the digitalisation of public health authorities. It should help increase the overall level of digital maturity in the public health offices and will also support the modernisation of the IT systems used for epidemiological surveillance in particular.

Furthermore, one measure in component 2.2 (Digitalisation of the economy) will contribute to the ‘Digital Rail Germany’ initiative, a programme gathering public and private stakeholders (including the Federal Railway Authority, research organisations and industry) with the objective of digitalising the railway system³⁷.

As far as the digitalisation of businesses is concerned, the recovery and resilience plan focuses on a sector of particular importance for Germany: automotive. A sizeable share of component 2.2 (Digitalisation of the economy) is indeed earmarked to help the whole sector take up the challenges of the digital transformation and reduce its environmental footprint, thus aiming at ensuring its sustainability. This will notably include a strong support to research and innovation projects.

The approach to digital skills addresses the two strategic priorities of the Digital Education Action Plan adopted in September 2020³⁸: (i) fostering the development of a high-performing digital education ecosystem, and (ii) enhancing digital skills and competences for the digital transformation. Component 3.1 (Digitalisation of education) is expected to reinforce previous initiatives launched by the federal government and the *Länder*, with the objective of enabling both teachers and students to take full advantage of the possibilities offered by digital technologies. One measure of this component will also address the modernisation of the

³⁴ COM(2016)179 - eGovernment action plan, 19 Apr 2016

³⁵ <https://digital-strategy.ec.europa.eu/en/news/ministerial-declaration-egovernment-tallinn-declaration>

³⁶ <https://digital-strategy.ec.europa.eu/en/news/berlin-declaration-digital-society-and-value-based-digital-government>

³⁷ <https://www.digitale-schiene-deutschland.de/en>

³⁸ COM(2020)624 - Digital Education Action Plan 2021-2027 Resetting education and training for the digital age, 30 September 2020

education institutions of the Federal Armed Forces. Moreover, both components 2.2 (Digitalisation of the economy) and 4.1 (Strengthening social inclusion) include measures on skills (continuing education and training networks and support to companies offering apprenticeships) which are expected to address digital skills to some extent.

The measures in component 2.1 (Data as the raw material of the future) is also expected to significantly contribute to addressing challenges related to key strategic technology areas. These include a comprehensive set of actions aiming at fostering data-driven innovation (in line with the European data strategy³⁹), as well as contributions to two multi-country projects on advanced technologies in the areas of microelectronics and cloud. Improving energy-efficiency of ICT systems and devices will be one of the main objectives of these two important projects. This innovation effort will be complemented by a measure in component 2.2 (Digitalisation of the economy) aiming at funding research and development projects carried out by the Centre for Digitalisation and Technology Research of the Federal Armed Forces (*Zentrum für Digitalisierungs- und Technologieforschung der Bundeswehr*) in areas such as cybersecurity, artificial intelligence, robotics, innovative mobility, and the digitalisation of energy.

This comprehensive set of measures is expected to have a lasting impact on Germany's ability to fully seize the opportunities offered by the digital transition and address the challenges resulting from it. They are expected to be instrumental in improving the delivery of public services to businesses and citizens. They are also expected to contribute to the needed improvement of digital skills in education and further training and to the long-term transformation of the automotive and health sectors, thus ensuring that Germany remains at the forefront of technological developments in strategic areas.

The proposed measures are aligned with the following three flagship initiatives identified in the Annual Sustainable Growth Strategy 2021⁴⁰:

- 'Modernise',
- 'Scale-Up',
- 'Reskill and Upskill'.

Taking into consideration the assessment of all the measures envisaged, the recovery and resilience plan is expected, to a large extent, to make a significant contribution to the digital transition and to address the challenges resulting from it and ensures that at least 20% of its total allocation contribute to supporting digital objectives. This would warrant a rating of A under criterion 2.6 of Annex V to the RRF Regulation.

³⁹ COM(2020)66 - A European strategy for data, 19 February 2020

⁴⁰ COM(2020) 575 - Annual Sustainable Growth Strategy 2021, 17 September 2020

4.7. Lasting impact of the plan

The recovery and resilience plan includes an ambitious package of measures aimed at addressing challenges identified in the context of the European Semester. The measures in the plan also support the green and digital transitions and strengthen the growth potential, job creation and economic and social resilience and cohesion of Germany. The proposed initiatives and investments are expected to have a lasting, positive impact on Germany's economy and society.

Most of the components of the plan are assessed as having a lasting impact on Germany. The measures presented in this respect comprise structural changes to the administration or relevant institutions and policies. The lasting impact results from policy areas where the estimated long-term impact on growth potential and employment is significant, as specified in Section 4.3, together with areas where structural changes are expected to improve social aspects that are not necessarily quantifiable.

Structural change in the administration and institutions

The plan presents structural changes in the country's public administration, education and healthcare. This is particularly the case in digitalisation of the country's public administration (component 6.1 Modern public administration), of health care (component 5.1 Strengthening a pandemic-resilient healthcare system), of the education system (component 3.1 Digitalisation of education). Other measures aim to ensure sufficient capacity and service supply of quality early childhood education and vocational training (component 4.1 Strengthening social cohesion). Not least, reforms in the public administration to streamline approval procedures involving public and private investments and disbursement of financial assistance are expected to lower administrative burden and barriers to investment (component 6.2 Reducing barriers to investment).

Investments in the digitalisation of public services are expected to have a lasting impact by expanding and consolidating IT infrastructures, which increase quality and efficiency of the respective providers. The implementation of the Online Access Act obliges the federal and regional government levels to group their administrative portals and link them to the Your-Europe Portal (6.1.2). Combined with measures to raise the digital competencies of staff, this shall create a modern technical infrastructure, enabling all levels of government to provide user-friendly services over an efficient platform system, compliant with the Single Digital Gateway Regulation.

The investment in public health services, complemented by relevant reforms, supports a lasting structural change in the coordination and cooperation between the various actors and levels of governance. The federal government will support financially the Pact for the Public Health Service aiming to reinforce staffing and the technical, including digital, capacity of public health services (5.1.2). The digitalisation of the public health services (5.1.1) as well as the investment in research on SARS-CoV-2 vaccines (5.1.3) tackle root causes not just of the pandemic, but also of difficulties in tracking and tracing the spread of viruses and in the coordination between the public health actors at national, regional and local levels. The

investment in the digitalisation of hospitals is expected to contribute to more efficient hospital care in the long run.

The investments and reforms in the education and training sectors is expected to boost their capacity to deliver relevant skills in an inclusive way. The measures of component 3.1 Digitalisation of education aim to close the gaps in the digital skills of teachers (3.1.3) and in the availability of equipment (3.1.1), and to create a national digital education platform to facilitate access to, and exchange of, educational material (3.1.2). Expanding quality early childhood education and care (4.1.1) and supporting apprenticeships (4.1.3) aim to enhance the opportunities for children and youth from vulnerable backgrounds to obtain the skills necessary to keep up with the requirements of the education system and the labour market.

Structural changes in policies

The plan consists of a set of measures putting emphasis on policies on the long-term sustainability and inclusiveness of economic growth. These measures address the take-up of carbon-free energy, low-emission mobility, and housing (components 1.1, 1.2, 1.3), support the digitalisation of the public administration (component 6.1), education (component 3.1), healthcare (component 5.1) and businesses (components 2.1 and 2.2), promote better access to skills for vulnerable youth (component 4.1), and remove barriers to public and private investment (component 6.2). Dealing with these challenges is indispensable to making economic growth sustainable and inclusive. These measures are expected to have a lasting beneficial effect on human capital, productivity and resource efficiency.

Lasting impact

Relative to a scenario without the RRF, Germany estimates that the RRF-financed investments and the reforms accompanying them will contribute to a 0.1% increase in the level of GDP after two years, a 0.2% increase after five years, and a 0.04% increase after twenty years. (See also Section 4.3 and Box 2.) The measures are expected to exert a positive impact on productivity beyond the duration of the plan.

Taking into consideration all reforms and investments envisaged by Germany in its recovery and resilience plan, their implementation is expected, to a large extent, to bring about a structural change in the administration or in relevant policies to a large extent and to have a lasting impact. This would warrant a rating of A under criterion 2.7 of Annex V to the RRF Regulation.

4.8. Milestones, targets, monitoring and implementation

The coordination unit in the Federal Ministry of Finance and the line Ministries have clearly assigned responsibilities and adequate structure for implementing the plan, monitoring progress and reporting. A coordination unit (*Koordinierungsstelle*) in the Federal Ministry of Finance is coordinating the work in the line ministries so that they altogether ensure an effective implementation of the plan. The coordination unit is staffed with economists, public finance and audit and control experts, and is coordinating the monitoring and reporting of progress on milestones and targets, relevant indicators, financial information and other data. It is also coordinating the monitoring and implementation of control and audit activities. In addition,

it is coordinating the reporting to the Commission including sending requests for payments, and is accompanying the process, identifying potential adjustment needs. In the line Ministries that are responsible for the implementation of the measures, central coordination units have been identified, and dedicated units have already been designated as primary contact points.

The milestones and targets of the German recovery and resilience plan enable an adequate monitoring of the plan's implementation. The implementation of the 40 measures in the plan is tracked through 129 milestones and targets, of which there are 54 milestones and 75 targets. Each measure has on average three milestones and targets. The first indicator is usually a milestone that tracks the initiation of implementation, often the publication of the relevant call for tender. The second indicator is a milestone or target that tracks interim progress, such as the achievement of certain performance or having reached a high level of budgetary execution. The third indicator is, wherever appropriate, a target tracking the accomplishment of a tangible objective, such as the outcome of a certain number of projects.

The monitoring indicators are sufficiently clear and comprehensive to ensure that their completion can be traced and verified. The milestones and targets represent mostly the key elements of the measures and as such can be considered relevant for their implementation. They adequately reflect the overall level of ambition of the plan and appear realistic. Limited changes to some of the submitted milestones and targets increased their specificity and their ambition. In a limited number of cases further specifications are foreseen, with the potential of increasing relevance.

The various arrangements to ensure an efficient and regular implementation of the plan are credible in terms of legal mandate and administrative capacity. The verification mechanisms, data collection systems and responsibilities described by the German authorities appear sufficiently robust to justify in an adequate manner the disbursement requests once the milestones and targets are completed. In addition, milestones and targets comprehensively cover sub-investments, and will allow to monitor the relevant aspects of the plan. Regular departmental meetings will be held with the line ministries responsible for technical matters on the implementation of the German plan. These meetings will also deal with, and coordinate the achievement of, milestones and targets.

The interaction between the monitoring and control systems are clear. The actors, their roles and the responsibilities of the internal control system are clearly described and the bodies are independent in their functioning. The coordination unit in the Federal Ministry of Finance will act as a counterpart for the European Commission, sign the management declaration provided for by Article 22(c)(i) of the RRF Regulation, and also countersign the summary of audits provided by the Court of Auditors (*Bundesrechnungshof*) as well as the audits and control reports from the internal control units (*Innenrevisionen*) within the implementing Ministries.

The arrangements proposed by Germany in its recovery and resilience plan are expected to be adequate to ensure effective monitoring and implementation of the recovery and resilience plan, including the envisaged timetable, milestones and targets, and the related indicators. This would warrant a rating of A under the assessment criterion 2.8 of Annex V to the RRF Regulation.

4.9. Costing

Germany has provided cost estimates for all investments and reforms included in the recovery and resilience plan for which funding through the RRF is requested. The recovery and resilience plan includes information on costing for each measure in a dedicated section. For cases with comparable projects in the past, there are comparisons, justifications and, if applicable, links to external sources and reports are sometimes indicated for further information.

The reforms and investments included in the plan comply with the eligibility criteria set out in the Regulation. All measures are set to be implemented and generate costs only after 1 February 2020, the initial cut-off date for eligible costs. According to the planned milestones and targets and associated payments requests, no funding is planned to be requested after 31 August 2026, which is the final cut-off date for eligible funding requests. The costing does not provide a detailed calculation of the potentially included value-added tax (VAT), which would not be an eligible cost under the RRF, except for very special circumstances. Instead, the plan demonstrates that the potential VAT generated by the plan is lower than the plan's oversubscription, ensuring that the financial contribution will not cover VAT.⁴¹

The assessment of costing in the plan did not reveal any indication that the reasonability of costs would be impaired. Information provided on costing for the different measures entails a varying degree of detail and completeness, while overall providing a reasonable explanation on key cost drivers. Further information on costing providing a greater depth of calculations and verifiable sources was requested following the submission of the plan and led overall to a higher level of assurance that estimated costs in the plan are reasonable.

As regards plausibility of costs, the information on costing provided gives no indication that costs would not be in line with the nature and type of the envisaged reforms and investments. The different types of measures entail varying degrees of challenges for providing costing information. In the case of funding programmes, where final beneficiaries have to submit applications for intended projects, ex-ante cost estimations are less precise than in the case of measures where the type and nature of projects is clearly defined from the beginning. Depending on the number of applications for the different types of projects and the volume of funding requested, the final costs are expected to vary in their nature and composition. For these reasons, Germany has argued for measures on planned IPCEIs and for demand-driven schemes that providing detailed information on the possible number and nature of projects to be funded by the respective measure has proven difficult and is possible only to a limited extent. However, for these demand-driven schemes, the costs to be covered by the RRF are in line with the funding needs in the given sectors, giving a degree of reassurance on the plausibility of the costs.

⁴¹ The recovery and resilience plan amounts to EUR 27.9 billion in non-repayable financial support. Completely excluding VAT for measures where it may be included, the plan corresponds to a net amount of at least EUR 26.5 billion. This still exceeds the allocation for non-repayable support for Germany (EUR 25.6 billion).

The plan states that costs to be financed by the RRF will not be funded at the same time by other EU funding sources, thus guaranteeing additionality of costs according to the Regulation. In a horizontal chapter of the plan, Germany gives assurance that double funding will be avoided and that administrative procedures are put in place to allow for a clear separation of costs so that the same costs are not funded by other EU funds.

The amount of the estimated total costs of the plan appears commensurate to the expected social and economic impact of the funded measures and in line with the principle of cost-efficiency. Many measures included in the plan are also part of the national Recovery and Future Plan that Germany adopted in June 2020. Measures of the recovery and resilience plan which are part of the national Recovery and Future Plan must follow the national rules on proper and sound financial management, which thus also apply to the recovery and resilience plan to this extent. The total measures put in place by Germany in the year 2020 alone amount to around 3.5% of GDP and, together with additional measures paid for in 2021, are projected to reach almost 10% of GDP. Compared to this benchmark, the total estimated cost of the plan is reasonable and in line with the principle of cost-efficiency given the envisaged social and economic impact of the funded measures.

Overall, the costing information presented in the plan complies with the minimum requirements on costing provided for by the Regulation. The costing information provided in the plan shows varying degrees of detail and depth of calculations. According to the information provided, reasonability, plausibility or additionality of costs as required by the Regulation are proven to a sufficient extent. However, more detailed estimations could have increased the level of assurance that these principles are fulfilled.

The justification provided by Germany on the amount of the estimated total costs of the recovery and resilience plan is to a medium extent reasonable, plausible, in line with the principle of cost-efficiency and commensurate to the expected national economic and social impact.

Germany provided sufficient information and evidence that the amount of the estimated cost of the reforms and investments of the recovery and resilience plan to be financed under the Facility is not covered by existing or planned Union financing.

This would warrant a rating of B under the assessment criterion 2.9 of Annex V to the RRF Regulation.

4.10. Controls and audit

The control function relies strongly on Germany's national set-up, resulting in adequate empowerment and administrative capacity. Audits and controls are performed mainly by the internal control units (*Innenrevisionen*) embedded in the ministries implementing the measures. They are audited by the Court of Auditors (*Bundesrechnungshof*, BRH) and coordinated by a central unit (comprising audit, economics and accounting experts) in the Federal Ministry of Finance, which will sign the management declaration and prepare the summary of audits. Since the ministries and other bodies described in the plan are part of Germany's national set-up, all these bodies have the legal mandate to exercise their tasks. It is explicitly stated in the plan that

progress on milestones and targets will be audited by them. The bodies have the administrative capacities and experienced staff. Personnel involved in the management of the plan is expected to receive training on specificities of the programme.

The internal control system is robust, with a clear distribution of roles and responsibilities, and the bodies are independent in their functioning. The control systems and other arrangements described in the plan are overall adequate. The plan explains the intentions regarding the audit strategy for the audit bodies to plan their audits, including a risk assessment, an indication of the frequency and type of audits, whether these will cover both the systems in place and the underlying actions (i.e. support given to final beneficiaries). There will be a group within the coordinating unit in charge of elaboration of the operational audit strategy based on risk assessment, followed by a prioritisation of audits. This group will work together with the ministries and their internal control units. The audits will include assessments on progress and verification of reported milestones and targets. The audits will be selected based on a risk analysis and in cooperation with the implementing ministries.

The national system's set-up ensures the protection of the EU's financial interests. The national system ensures the prevention, detection and correction of fraud, corruption, double funding, and conflicts of interest. It also guarantees the accuracy of the data underlying milestones and targets. Due to the absence of a dedicated IT system, the data collection and verification are rather based on supervision, monitoring and reporting from implementing bodies back to coordination bodies. However, a full audit trail and full access to data is guaranteed at any moment in time.

The national laws and regulations are considered efficient in preventing, detecting and correcting serious irregularities like fraud, corruption and conflict of interest. There are standardised internal control procedures, checks and audits in the implementing public bodies, together with a regulatory framework concerning behaviour of officials, declarations on absence of conflicts of interest where appropriate, and reporting of fraud. The law to prevent corruption (from 2004) is also applicable to the recovery and resilience plan. In all Ministries there are measures in place to fight corruption and fraud and independent dedicated persons are nominated for that purpose. Suspected fraud is dealt with by the offices fighting white-collar crime (*Dienststellen für Wirtschaftskriminalität*).

The arrangement to avoid double EU funding is adequate. The coordinating unit in the Ministry of Finance performs checks on double funding as part of their tasks of monitoring, supervision, and coordination. In the first place, measures in the plan do not combine funding with other EU funds, therefore the risk for double funding is intrinsically limited. The plan states that in case of parallel funding of measures and projects from different EU sources, adequate reporting will make sure that the same costs are not reimbursed several times.

Decision quality and integrity benefit from a systemic separation of funding streams and the system of individual commitments. This separation follows the German financial regulation (*Haushaltsordnung*) and possible cross-checks are to be made in the database of support recipients (*Förderdatenbank*). The plan announces that it will be checked how

ARACHNE, the European Commission's data mining and risk scoring tool, could complement or integrate data from the database of German support recipients.

Payments made under the funding guidelines benefit from a high degree of clarity. Various measures in the plan are based on funding guidelines (*Förderrichtlinien*), which set out detailed specifications on funding objectives, projects and types of beneficiaries eligible, kind and amount of funding, application guidelines, project approval and payment conditions. These checks have to be applied by implementing bodies which can be easily controlled by internal control units as well as the Court of Auditors as provided for by the plan.

Data management could be made more efficient. The data encoding takes place in decentralised IT systems across ministries, which are obliged to report the required data to the coordinating unit in the Federal Ministry of Finance. Access to the data (e.g. on final recipients in the subsidiaries databases) is granted to all relevant EU bodies upon request. Shortcomings regarding the practical arrangements and the audit trail for checking milestones and targets (in the absence of a central IT system) have been identified by the Commission services, as Germany only mentions the mandatory national full communication chain and reporting lines ranging from coordinating bodies via implementing bodies down to final recipients. These, however, appear to be rather a question of efficiency than of Germany's ability to provide sound reporting and verification of progress on milestones and targets. Germany has started a process to have its IT system audited by the Court of Auditors (*Bundesrechnungshof*) to identify possible weaknesses and to address without delay any recommendations of the audit report, as well as to ensure the complete recording of all data referred to in paragraph (d) of Article 22(2) of Regulation (EU) 2021/241, including by a transitional system. Germany committed to providing access to such data.

The arrangements proposed by Germany in the recovery and resilience plan to prevent, detect and correct corruption, fraud and conflicts of interest when using the funds provided under the Facility, including the arrangements aimed to avoid double funding from the Facility and other Union programmes, are assessed to be adequate. This would warrant a rating of A under the assessment criterion 2.10 of Annex V to the RRF Regulation.

4.11. Coherence

The German recovery and resilience plan has a coherent and convincing narrative focused on the green and digital transitions. The plan builds on the national support package from June 2020 and complements it with planned IPCEIs on green hydrogen (1.1.1), cloud (2.1.3) and microelectronics (2.1.2), and with reforms to reduce barriers to investment (6.1.1 and 6.1.2). The plan has a clear strategic focus with coherent actions at all levels – within each component, across the components and among individual measures in the different components.

Mutually reinforcing measures

The reforms and investments in the components are coherent and mutually reinforcing. Within each component, the measures are targeted to achieve coherent objectives and their expected results are reinforcing each other. Municipal living labs for the energy transition

(1.3.2), for example, test new ways to decarbonise energy needs for buildings and thus feeds into the building renovation measure (1.3.3). Similarly, measures 1.2.1 to 1.2.4 in component 1.2 Climate-friendly mobility mutually reinforce each other in supporting sustainable mobility from different angles – through investment in infrastructure for electric vehicles combined with purchase and tax incentives for low- and zero-emission vehicles. The measure to strengthen the digital and technical resources of the public health service (5.1.1) and the programme for future-proof hospitals (5.1.2) respond to the reform and investment needs for the digitalisation of the healthcare sector, contribute to digitalising the economy and, together with research on SARS-CoV-2 vaccines (5.1.3), effectively address the pandemic.

Structural reforms accompany the investment priorities to reinforce the impact of planned investment. A clear example are the reforms in component 6.2 Reducing barriers to investment. The joint programme of the Federal Government and the *Länder* for an efficient administration that benefits citizens and businesses (6.2.1), the support for local authorities through *PD – Berater der öffentlichen Hand GmbH* in the effective implementation of investment funding (6.2.2) and the legal measures to speed up planning and authorisation procedures in particular in the transport sector (6.2.3) are all set to strengthen the public sector's capacity to implement the investment measures under the German recovery and resilience plan in a faster and more efficient manner, for example in the areas of education or healthcare and also in the area of energy-efficient building renovation. The implementation of these reforms is also expected to benefit businesses and citizens by cutting red tape and expediting administrative procedures.

Complementarity of measures

The components pursue complementary aims with clearly discernible overarching strategic objectives. There are synergies between the components with regard to both pursued objectives and concerted approach towards reforms and investments. The digital transformation of the economy, for instance, in component 2.2, is complemented by reforms on data infrastructure (component 2.1) and investments in digital education and skills (component 3.1) and is closely linked to the digitalisation of the public administration (component 6.1) and of the health sector (component 5.1). Similarly, climate protection and climate change mitigation as overarching objectives of the plan are reflected in investments in green hydrogen (component 1.1), reforms and investments to promote sustainable mobility (component 1.2) and energy-efficient building renovation (component 1.3). In addition, the production of clean hydrogen (component 1.1) is integral to the use of hydrogen for sustainable mobility (component 1.2). Some components mutually reinforce each other. For example, component 1.3 also promotes digitalisation of the timber construction sector and in buildings. At the same time, also component 2.2 pays attention to energy-efficiency and sustainable solutions.

Individual measures also show the intrinsic complementarity between the components. The effectiveness of investment in the digitalisation of education (component 3.1), which aims to improve pupils' and teachers' digital skills and promote access to learning materials through the education lifecycle, is strengthened by the focus on the education of vulnerable groups (4.1.4) and the expansion of quality early childhood education and care, a key policy lever for reducing learning disadvantages (4.1.1).

No instances of measures within any component that may contradict or undermine each other's effectiveness were identified. There are no conflicts between the aims, the envisaged implementation of the reforms and investments and their expected effect.

In view of the challenges faced by Germany, the recovery and resilience plan presents a balanced approach between reforms and investments. As elaborated in Section 1.2 of the plan, it addresses a significant subset of the country-specific recommendations addressed to Germany in the context of the European Semester, making the proposed reforms and investments appropriate. In order to promote wider coherence across instruments, notably with the European cohesion policy funds, a balanced territorial allocation of resources is encouraged.

Taking into consideration the qualitative assessment of all components of Germany's recovery and resilience plan, their individual weight (importance, relevance, financial allocation) and their interactions, the plan contains measures for the implementation of reforms and public investments which, to a high extent, represent coherent actions. This would warrant a rating of A under the assessment criterion 2.11 of Annex V to the RRF Regulation.

ANNEX: CLIMATE TRACKING AND DIGITAL TAGGING TABLE ⁴²

Measure/ Sub-Measure ID	Measure/Sub-Measure Name	Budget (EUR m)	Climate		Digital	
			Int. Field	Coeff. %	Int. Field	Coeff. %
1.1.1.1	Hydrogen projects within the framework of IPCEIs: part 1	500	022	100%		
1.1.1.2	Hydrogen projects within the framework of IPCEIs: part 2	500	027	100%		
1.1.1.3	Hydrogen projects within the framework of IPCEIs: part 3	500	033	100%		
1.1.2	Funding programme for decarbonisation in industry	449.3	022	100%		
1.1.3	Pilot scheme for climate action contracts based on the principle of Carbon Contracts for Difference	550	027	100%		
1.1.4	Project-related climate protection research	50.4*	022	100%		
1.1.5	Flagship projects for research and innovation in the context of the National Hydrogen Strategy	588.2*	022	100%		
1.2.1	Support for the construction of charging infrastructure	700	077	100%		
1.2.2.1	Funding for the development of electro-mobility: R & D, mobility concepts	42*	022	100%		
1.2.2.2	Funding for the development of electro-mobility: zero-emission vehicles	21*	n/a**	100%		
1.2.3.1	Support for the replacement of the private vehicle fleet: zero-emission vehicles	1364	n/a**	100%		
1.2.3.2	Support for the replacement of the private vehicle fleet: hybrid vehicles.	1 136	n/a**	40%		
1.2.4	Extension of the initial registration period for granting the ten-year tax exemption for purely electric vehicles	295	n/a**	100%		
1.2.5	Support for purchases of buses with alternative propulsion	1 085	n/a**	100%		

⁴² While the total cost of Germany's recovery and resilience plan exceeds the total allocation of non-repayable financial support to Germany, Germany will ensure that all spending related to the investments mentioned in the following table as contributing to climate objectives are fully financed by the funds from the Recovery and Resilience Facility.

Measure/ Sub-Measure ID	Measure/Sub-Measure Name	Budget (EUR m)	Climate		Digital	
			Int. Field	Coeff. %	Int. Field	Coeff. %
1.2.6.1	Support to promote alternative rail propulsion: electric rolling stock	182	072bis	100%		
1.2.7.1	Promotion of the industries involved in hydrogen and fuel cell applications in transport: part 1	229.4*	022	100%		
1.2.7.2	Promotion of the industries involved in hydrogen and fuel cell applications in transport: part 2	229.4*	n/a**	100%		
1.3.2	Municipal living labs for the energy transition	57	025	40%		
1.3.3	Building renovation: federal funding for energy-efficient buildings	2 500	025bis	100%		
2.1.1.1	Innovative data policy for Germany: overall strategy high-performance computing	21*			021quarter	100%
2.1.1.2	Innovative data policy for Germany: ideas competition and piloting of data fiduciaries	45.4*			009bis	100%
2.1.1.3	Innovative data policy for Germany: research network depersonalisation	37.8*			009bis	100%
2.1.1.4	Innovative data policy for Germany: support programme anonymisation	25.2*			009bis	100%
2.1.1.5	Innovative data policy for Germany: National Research Data Infrastructure (<i>Nationale Forschungsdateninfrastruktur</i>) and data literacy	50.4*			108	100%
2.1.1.6	Innovative data policy for Germany: PhD programme in data sciences	5.5*			108	100%
2.1.1.7	Innovative data policy for Germany: incentives for the after-use of data	4.2*			108	100%
2.1.1.8	Innovative data policy for Germany: long-term competence monitoring	8.0*			108	100%
2.1.1.9	Innovative data policy for Germany: data literacy courses for students	8.8*			108	100%
2.1.1.10	Innovative data policy for Germany: toolbox data literacy	8.4*			108	100%
2.1.1.11	Innovative data policy for Germany: innovation process 'architectures, institutions and	6.7*			108	100%

Measure/ Sub-Measure ID	Measure/Sub-Measure Name	Budget (EUR m)	Climate		Digital	
			Int. Field	Coeff. %	Int. Field	Coeff. %
	spaces for the data society'					
2.1.1.12	Innovative data policy for Germany: establishment of data cooperations	11.3*			011	100%
2.1.1.13	Innovative data policy for Germany: data literacy in the federal administration: data laboratories, Chief Data Scientists and competence building	200.8*			108	100%
2.1.2.2	IPCEI microelectronics and communication technologies	1 500			021quarter	100%
2.1.3.1	IPCEI Next Generation Cloud Infrastructure and Services (IPCEI CIS): emission reduction and energy efficiency criteria	375	055bis	40%	021quarter	100%
2.1.3.2	IPCEI Next Generation Cloud Infrastructure and Services (IPCEI CIS)	375			021quarter	100%
2.2.1.1	Vehicle manufacturer/supply industry investment programme: digitalisation of production as a boost for productivity and resilience: greenhouse gas emission reduction or energy efficiency criteria	650	010ter	40%	010ter	100%
2.2.1.2	Vehicle manufacturer/supply industry investment programme: digitalisation of production as a boost for productivity and resilience	427.1			010ter	100%
2.2.1.3	Vehicle manufacturer/supply industry investment programme: new innovative products as the key to vehicles and mobility of the future - automated driving	392.67			009bis	100%
2.2.1.5	Vehicle manufacturer/supply industry investment programme: finding joint solutions, building regional innovation clusters	232.4			019	40%
2.2.2	Federal programme 'Building continuing education and training networks (CET networks)'	31.9*			016	40%
2.2.3	Digitalisation and Technology Research Centre of the	588.2*			009bis	100%

Measure/ Sub-Measure ID	Measure/Sub-Measure Name	Budget (EUR m)	Climate		Digital	
			Int. Field	Coeff. %	Int. Field	Coeff. %
	Bundeswehr (dtec.bw)					
2.2.4	Promoting the digitalisation of rail by replacing conventional interlocking/fast-track programmes to speed up the roll-out of the 'Digital Rail Germany' (SLP)	500			070	100%
3.1.1	Investment programme for teacher devices	420.2*			012	100%
3.1.2	Education platform	529.4*			012	100%
3.1.3	Educational centres of excellence	172.3*			108	100%
3.1.4	Modernisation of the Federal Armed Forces' educational and training facilities	84*			012	100%
4.1.3	Apprenticeships support	725			099	40%
4.1.5	Digital pension overview	34.3			011	100%
5.1.1	Strengthening the digital and technical resources of the public health service	684*			011	100%
5.1.2	Programme to future-proof hospitals	2 521*			095	100%
6.1.1	European identity ecosystem	168.1*			011	100%
6.1.2	Digitalisation of the administration – implementation of the Online Access Act	2521*			011	100%
6.1.3	Digitalisation of the administration – modernisation of registers	231.1*			011	100%

* Budget figures are rounded to hundred thousands. The table shows the cost of the measures without VAT. For most measures this equals the cost included in the recovery and resilience plan. However, for measures marked with an asterisk (*), Germany indicated that their cost may include VAT, and in this table the cost is shown while taking away the full amount of potential VAT for these measures (assuming that the maximum VAT rate of 19% fully applies). Without adjusting for VAT, the cost of the plan is EUR 27 949.9 million, while adjusting for VAT yields a total budget of at least EUR 26 518.8 million, with a climate quota of at least 42.4% and a digital quota of at least 52.6%.

** The 'Methodology for climate tracking' annexed to the Recovery and Resilience Facility Regulation does not set out intervention fields that would allow for climate or environmental tracking of electric vehicles or plug-in hybrid vehicles, except for vehicles for urban transport falling under intervention field 074. According to Article 18(4)(e) of the Regulation, the methodology should however 'be used accordingly for measures that cannot be directly assigned to an intervention field listed in Annex VI'. In this context, the Commission has applied a 100% climate contribution coefficient for zero-emission vehicles of all categories (this includes battery electric and fuel cell/hydrogen-powered vehicles); a 40% climate contribution coefficient for plug-in hybrid light-duty vehicles; and, in line with the criteria under the Taxonomy Regulation, a 100% climate coefficient for low-emission heavy-duty vehicles.

REFERENCES

Agora Energiewende (2020), *Towards a climate-neutral Germany. Three steps for achieving climate neutrality by 2050 and an intermediate target of -65% in 2030 as part of the EU Green*

Deal (https://static.agora-energiewende.de/fileadmin/Projekte/2020/2020_10_KNDE/A-EW_193_KNDE_Executive-Summary_EN_WEB_V111.pdf).

Agora Energiewende and Sandbag (2020), *The European Power Sector in 2019 – Up-to-date analysis on the electricity transition* (https://static.agora-energiewende.de/fileadmin/Projekte/2019/Jahresauswertung_EU_2019/172_A-EW_EU-Annual-Report-2019_Web.pdf).

Agora Energiewende and Wattsight (2020), *Die Ökostromlücke, ihre Strommarkteffekte und wie sie gestopft werden kann. Effekte der Windenergiekrise auf Strompreise und CO₂ Emissionen sowie Optionen, um das 65-Prozent-Erneuerbare-Ziel 2030 noch zu erreichen* (https://www.agora-energiewende.de/fileadmin2/Projekte/2020/2020-01_DE-RE-Boost-2030/177_A-EW_Oekostromluecke-stopfen_WEB.pdf).

Benedetti-Fasil, C., Del Rio, J.C., Domnick, C., Fako, P., Flachenecker, F., Gavigan, J., Janiri, M., Stamenov, B., and Testa, G. (2021), *High growth enterprises in the COVID-19 crisis context*, EUR 30686 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-37269-1, doi:10.2760/63402, JRC124469.

Bundesfinanzministerium (BMF) (2021), *German stability programme 2021* (https://ec.europa.eu/info/sites/default/files/2021-germany-stability-programme_en.pdf).

Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU) (2020), *Digital policy agenda for the environment*, (https://www.bmu.de/fileadmin/Daten_BMU/Pool/Broschueren/broschue_digital_agenda_eng_bf.pdf).

Bundesministerium für Verkehr und digitale Infrastruktur (BMVI) (2020), *Breitbandatlas Langbericht* (Stand Mitte 2020) (<https://www.bmvi.de/SharedDocs/DE/Artikel/ZukunftBreitband/breitbandatlas-langbericht.html>).

Bundesnetzagentur und Bundeskartellamt (BNA, BKA) (2021), *Monitoringbericht 2020* (https://www.bundesnetzagentur.de/SharedDocs/Mediathek/Berichte/2020/Monitoringbericht_Energie2020.pdf).

Bundesverfassungsgericht (BVerfG) (2021), *Beschluss des Ersten Senats vom 24. März 2021 - 1 BvR 2656/18 -, Rn. 1-270* (http://www.bverfg.de/e/rs20210324_1bvr265618.html).

Castellazzi, L., Zangheri, P., Paci, D., Economidou, M., Labanca, N., Ribeiro Serrenho, T., Zancanella, P., and Broc, J. (2019), *Assessment of second long-term renovation strategies under the Energy Efficiency Directive*, EUR 29605 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-98727-4, doi:10.2760/973672, JRC114200.

Christl, M., De Poli, S., Hufkens, T., Peichl, A., and Ricci, M. (2021), ‘The role of short-time work and discretionary policy measures in mitigating the Effects of the COVID-19 Crisis in Germany’, *JRC Working Papers on Taxation and Structural Reforms*, 04-2021, (forthcoming).

Cisco and IDC (2020), *2020 Small business digital maturity study* (<https://www.cisco.com/c/en/us/solutions/small-business/resource-center/small-business-2020-digital-maturity-study.html>).

Clemens, M., Düding, J. S., Goerge, M., Kemfert, C., Michelsen, C., and Neuhoﬀ, J. (2021), Quantitative und qualitative Wirkungsanalyse der Maßnahmen des Deutschen Aufbau- und Resilienzplans (DARP): ‘Endbericht; Kurzexpertise im Auftrag des Bundesfinanzministeriums (fe 3/19)’, *Politikberatung kompakt*, DIW Berlin, 168. (https://www.diw.de/de/diw_01.c.817155.de/publikationen/politikberatung_kompakt/2021_0168/quantitative_und_qualitative_wirkungsanalyse_der_massnahmen__expertise_im_auftrag_des_bundes__nanzministeriums__fe_3/19.html).

Economic Policy Committee and European Commission (EPC, EC) (2021), ‘The 2021 Ageing Report: economic and budgetary projections for the 27 EU Member States (2021-2070)’, *European Economy, Institutional Paper 148*, Directorate General Economic and Financial Affairs, European Commission (https://ec.europa.eu/info/sites/default/files/economy-finance/ip148_en_0.pdf).

Economidou, M., Ringel, M., Valentova, M., Zancanella, P., Tsemekidi-Tzeiranaki, S., Zangheri, P., Paci, D., Serrenho, T., Palermo, V., and Bertoldi, P., (2020), *National Energy and Climate Plans for 2021-2030 under the EU Energy Union: Assessment of the Energy Efficiency Dimension*, EUR 30487 EN, Publications Office of the European Union, Luxembourg, 978-92-76-27013-3, doi:10.2760/678371, JRC122862

European Commission (2021a), ‘Debt sustainability monitor’, *Institutional Paper 143*, Brussels.

European Commission (2021b). ‘Productivity and competitiveness developments in the EU’, *Joint ECFIN-JRC Background and Policy Note (Internal Communication)*, Brussels.

European Commission (2021c), ‘Preliminary analysis of the long-term renovation strategies of 13 Member States’, *Commission Staff Working Document*, (2021)69 (https://ec.europa.eu/energy/sites/default/files/swd_commission_preliminary_analysis_of_member_state_ltrss.pdf).

European Commission (2020a), *Country report Germany 2020*, European Commission, Brussels (<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1584543810241&uri=CELEX%3A52020SC0504>).

European Commission (2020b), *eGovernment benchmark 2020 report* (<https://ec.europa.eu/digital-single-market/en/news/egovernment-benchmark-2020-egovernment-works-people>).

European Commission (2020c), *Deutschland: Monitor für die allgemeine und berufliche Bildung 2020* (https://op.europa.eu/webpub/eac/education-and-training-monitor-2020/countries/germany_de.html).

European Commission (2020d), ‘Germany’, *Digital economy and society index 2020*, European Commission, Brussels (https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=66916).

European Commission (2019a), ‘The EU environmental implementation review 2019 – country report Germany’, *Commission Staff Working Document*, (2019)137 (https://ec.europa.eu/environment/eir/pdf/report_de_en.pdf).

European Commisison (2019b), *Country report Germany 2019*, European Commission, Brussels (https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-report-germany_en.pdf).

Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (GCEE) (2020), *Jahresgutachten 2020/21*, Berlin.

Leifels, A. (2021): ‘Weiterbildung bricht in der Krise ein - Bedarf an Digitalkompetenzen wächst’, *Fokus Volkswirtschaft*, 329, KfW Research.

Milasi S., González-Vázquez, I., and Fernández-Macías, E. (2020), ‘Telework in the EU before and after the COVID-19: where we were, where we head to’, *JRC Science for Policy Briefs*, European Commission.

Organisation for Economic Co-operation and Development (OECD) (2020), *OECD economic surveys: Germany 2020*.

Shnapp, S., Paci, D., and Bertoldi, P., (2020), *Enabling Positive Energy Districts across Europe: energy efficiency couples renewable energy*, EUR 30325 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-21043-6, doi:10.2760/452028, JRC121405.

Sostero, M, Milasi, S., Hurley, J., Fernandez-Macias, E., and Bisello, M (2020), ‘Teleworkability and the COVID-19 crisis: a new digital divide?’, *JRC working paper series on Technology Labour and Education*, European Commission.

Umweltbundesamt (UBA) (2021), *Finale Treibhausgasbilanz 2019: Emissionen sinken um 35 Prozent gegenüber 1990* (<https://www.umweltbundesamt.de/presse/pressemitteilungen/finale-treibhausgasbilanz-2019-emissionen-sinken-um>).

Umweltbundesamt (UBA) (2020a), ‘Treibhausgasminderungswirkung des Klimaschutzprogramms 2030 (Kurzbericht)’, *Ressortforschungsplan des Bundesministeriums*, Dessau-Roßlau.

Umweltbundesamt (UBA) (2020b), ‘Sustainable pathways out of the corona crisis. The German case’, *Position paper* (https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2020_pp_nach_haltige_wege_englisch_bf_titel-neu.pdf).

Umweltbundesamt (UBA) (2019), *Die Umweltschutzwirtschaft in Deutschland 2019. Produktion, Umsatz und Außenhandel*.

Varga, J and in 't Veld, J. (2014), ‘The potential growth impact of structural reforms in the EU: a benchmarking exercise’, *European Economy Economic Papers*, 541 (http://ec.europa.eu/economy_finance/publications/economic_paper/2014/pdf/ecp541_en.pdf).

Zangheri, P., Armani, R., Kakoulaki, G., Bavetta, M., Martirano, G., Pignatelli, F., and Baranzelli, C. (2020), *Building energy renovation for decarbonisation and Covid-19 recovery. A snapshot at regional level*, EUR 30433 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-24766-1, doi:10.2760/08629, JRC122143.