POLICY BRIEF
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FEPS
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HOW TO ADDRESS EUROPE'S GREEN INVESTMENT GAP

SUMMARY

This policy brief discusses the European Union's investment needs to limit global warming to 1.5°C above pre-industrial levels as well as two funding options to raise the revenues for the direct provision of green infrastructure. The policy brief finds that the European Commission's modelling of required investment needs is overly optimistic as the EU faces an investment gap of €11,670 to €16,320 billion between 2020 and 2050.

A progressive European wealth tax and the issuing of government bonds for a public investment initiative are two policy options to close this gap. A progressive European wealth tax has the potential to raise revenues of between €164 billion and €357 billion annually, while not increasing inflationary and Covid-related pressures on low- and middle-income households. A wealth tax can also reduce extreme levels of wealth inequality and build administrative capacities to fight corruption and organised crime. The second policy option of issuing bonds can raise revenues instantly and will generate a significant economic impulse. This policy brief estimates a long-run investment multiplier of 5 for a co-ordinated fiscal expansion at the EU level. The magnitude of the multiplier also means that public finances will improve in the long term.

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1. Introduction

The climate crisis the world and the EU is facing is more serious than ever. The most recent assessment of the climate system by the 6th report of the Intergovernmental Panel on Climate Change (IPCC 2021) and the UN's Emissions Gap report (United Nations Environment Programme 2021) is bleak.[1] The most optimistic of the analysed scenarios (SSP1-1.9)[2] is designed to keep global temperatures around 1.5°C above pre-industrial levels and assumes that global greenhouse gas (GHG) emissions reach net zero by 2050. In addition, it assumes a slowing of population growth, reductions in global income inequality and high levels of international co-operation and co-ordination to achieve net zero by 2050.

Based on current policies, however, the world is on course for 2.7°C of warming by the end of the century, lying very far off a Paris-compliant path (United Nations Environment Programme 2021). In addition, the enormous complexity of the climate system means that there are significant uncertainties attached to these predictions. For example, even under the SSP1-1.9 scenario (Paris compliant), the very likely range of global surface temperature increase between the years 2041 to 2060 ranges from 1.2°C to 1.6°C. Overall, the IPCC scientists' message is clear:

> *The remaining carbon budget is small, every tonne of CO_2 emissions adds to global warming, and emissions must fall to net zero by mid-century in order for us to avoid the most dangerous climate change.* (IPCC 2021)

The global nature of the problem has two important implications for climate policy in Europe. First, reaching net zero by 2050 globally will require the world's rich nations, including the EU, to reach net zero before 2050. On the one hand, the EU has been emitting GHG emissions for much longer than most low- and middle-income countries and has thus contributed more to the problem over time.[3] On the other hand, it is the rich nations that have the resources to act quickest. Ignoring differences in the ability to act will make it very difficult to reach the global co-operation which the 2050 net zero goal requires. **The second implication for EU climate policy stems from the fundamental uncertainties attached to the climate system.** Given these uncertainties, planning for a precision-landing of reaching net zero by 2050 is a risky bet. The approach should be to err on the side of caution and reach net zero in the EU well before 2050. Every tonne of CO_2 not emitted will make it more likely that humanity succeeds in limiting warming to 1.5°C.

It is against this background that this policy brief looks at the EU's climate policy and synthesises the results of the FEPS research project 'A fiscally sustainable public investment initiative in Europe to prevent climate collapse', the results of which have been published in detailed policy studies (Wildauer et al 2020; Kapeller et al 2020; Wildauer et al 2021). Three important lessons emerge. **First, member states and the European Parliament should use the ongoing discussions on the Fit for 55 (FF55) package of legislative proposals to implement the European Green**

1 Temporary emission reductions due to COVID will have little impact. Global emissions fell by 6% during 2020 and were forecast to rise to 1% below 2019 levels during 2021. See IEA (2021), Global Energy Review 2021.

2 The IPCC defines the SSP1-1.9 scenarios as '… scenarios with very low and low GHG emissions and CO2 emissions declining to net zero around or after 2050, followed by varying levels of net negative CO2 emissions.'

3 Cumulative CO_2 emissions per capita in 2020 stood at 1260 tons for the USA, 1160 tons for the UK, 1100 for Germany, 580 for France and 170 for China.

Deal (EGD) to upgrade its scale and ambition. Sticking to the Paris Agreement will require more ambitious 2030 as well as more ambitious 2050 climate targets. In particular, significantly more green investment spending is required. **Second, a European wealth tax would be a potent way of funding the required green infrastructure** while in addition reducing inequality and helping to combat crime and corruption in the EU and globally. **Third, issuing government bonds to fund public investment spending yields large economic benefits**, especially if implemented in a co-ordinated way, leaving public finances in better shape than without such an initiative.

The scale of the climate crisis requires bold and fast action. Most importantly, however, it requires global co-operation on an unprecedented scale. **This means that achieving climate targets locally is not enough.**

The policies outlined in this report would not only allow for fast and effective climate action locally but would also increase the EU's international credibility by giving poorer nations more time, by spearheading the development (and sharing) of green technologies and by helping low- and middle-income countries build more resilient political systems by increasing financial transparency.

2. Estimating Europe's green investment gap

A credible decarbonisation strategy requires a fundamental overhaul of our energy infrastructure. Therefore, this policy brief starts with an assessment of the EU's current package of climate policies, most importantly the **European Green Deal (EGD)** (COM 2019) and the **Fit for 55 (FF55)** (COM 2021) package of legislative proposals to implement the EGD. The focus of the analysis is on the projected investment requirements and the gap to current investment trends. Section 2.1 provides an overview of the EU's climate targets for 2030 and 2050 and section 2.2 presents the European Commission's assessment of the investment needed to achieve these. Section 2.3 puts the Commission's investment estimates in context with the scientific literature.

2.1 EU climate policies

EU climate policy has undergone a raft of changes in the recent past. This section compares the EGD, its predecessor the **A Clean Planet for All (CPfA)** (European Commission 2018a) strategy, and the FF55 package. Table 1 shows the emissions reduction as well as renewable energy production and energy efficiency targets for each strategy.

While the CPfA proposal did not introduce new intermediate or long-term emission reduction targets over those which had previously existed,[4] it provided a new impact assessment (European Commisison 2014). According to this assessment, existing 2018 policies were likely to yield an emissions reduction of at least 45 percent by 2030, thus comfortably reaching the -40 percent target by 2030. As a result (and discussed in more detail in the next section), the CPfA impact assessment did not find an investment gap for the 2021 to 2030 period. The outlook for the 2031 to 2050 period was less optimistic, since existing policies would not

4 The EU Commission had already set a long-term objective in 2009 to reduce greenhouse gas emissions by 80-95% compared to 1990 levels by 2050 (European Commission 2018a, 17).

Table 1: EU climate targets

Targets for 2030	Clean Planet for All (2018)	European Green Deal (2020)	Fit for 55 (2021)	Scientific Literature
GHG emissions reduction (1990 levels)	-40%	-50% to -55%	-55%	-65%[A]
Share of renewables in energy production	32%	32%	40%	72%[B]
Improvements in energy efficiency	32.5%	32.5%	40%	

A. Anderson and Stoddard (2020) argue that a 75% reduction is necessary for energy CO_2 emissions only. The underlying carbon budget of at most 27 GtCO2 is also consistent with Constrain (2019). Greenpeace argues that at least 65% reduction is required to achieve net zero emissions by 2040.
B. Anderson and Stoddard (2020) argue for zero carbon energy production between 2035 and 2040. The EU27's share of renewables in energy production was 19% in 2017. Simply assuming a linear increase of 4 percentage points annually leads to a renewable share of 72% in 2030.

have achieved the 2050 carbon neutrality target – only achieving a 60 percent reduction on 1990 levels. In addition, it also evaluated several scenarios that would deliver net zero emissions for the EU28 by 2050. Importantly, these net zero scenarios achieve this outcome through a variety of highly questionable assumptions, most importantly the large-scale deployment of yet undeveloped carbon-capture technologies.[5]

Following the CPfA strategy, the EGD initially proposed an increase in 2030 emission targets from a 40 percent reduction to a 50-55 percent reduction which was finalised as a 55 percent reduction with the FF55 package. The FF55 impact assessment projects an emissions reduction of -46 percent compared to 1990 levels by 2030 based on current policies. Thus, setting a new target of -50 percent and even -55 percent is not very ambitious, especially since the first steps towards a carbon neutral society are easier to achieve and implement than the final steps. Nevertheless, achieving the new 55 percent goal requires additional efforts which FF55 acknowledges. With respect to the longer-term outlook, current policies would only achieve a reduction of 62 percent by 2050, which means no real progress has been made in the two years between these impact assessments (2018 to 2020).

5 SWD (2020) 176 final – Impact Assessment Part 2/2 states on pages 97 and 149 that by 2050 negative emissions of about 500 MtCO2eq annually are required to reach net zero.

2.2 European Commission's investment gap estimates

The European Commission's impact assessment of the CPfA strategy painted an overly optimistic picture about the short term. In the next decade from 2021 to 2030, the then current policy framework was deemed sufficient to reach the goal of an emissions reduction of -40 percent compared to 1990 levels by 2030. Thus, the Commission's assessment based on the Commission's model suite[6] concluded no additional spending was required beyond current plans. Only after 2030 would additional investments be required to reach net zero by 2050. The Commission's estimate puts the additional investment requirement for the total energy system, including transportation, at €255 billion annually.[7] This reveals a fundamental shortcoming of EU climate policy over at least the last decade. Instead of swiftly beginning an ambitious plan, as recently as 2018 the European Commission was confident that current efforts are sufficient for the next decade and only then would additional measures be required.

Table 2: Investment spending under CPfA and FF55 scenarios

	Clean Planet for All (2018)[8]			Fit for 55 (2020)[9]			
	Current policies (1)	-40% by 2030 (2)	Gap = (2) - (1)	Current policies (3)	-55% by 2030 (4)	Gap = (4) - (3)	ΔGap = (3) - (1)
2021-2030 average							
Total energy system	952	952	0	947	1,055	108	108
Total excl. transport	349	349	0	336	434	98	98
2031-2050 average							
Total energy system	1,048	1,303	255	981	1,196	215	-40
Total excl. transport	332	507	175	284	470	186	11
2021-2050 aggregate							
Buildings	6,775	7,634	859	6,126	8,102	1,976	1,117
Total energy system	30,474	35,581	5,107	29,081	34,467	5,386	279
Total excl. transport	10,126	13,630	3,504	9,036	13,743	4,707	1,203

6 SWD (2020) 176 final – Impact Assessment Part 2/2. Section 9.3.1.1
7 In EC 2018 Table 10, the corresponding value is €290 billion at 2013 prices. Scale this to 2015 prices and reduce it by 16% to account for Brexit as the original figure was based on the EU28.
8 European Commission (2018b) – Table 10, Baseline and 1.5TECH.
9 SWD (2020) 176 final – Impact Assessment Part 2/2. Table 46, BSL and ALLBNK.

This is in stark contrast to every single publication by the Intergovernmental Panel for Climate Change (IPCC) and numerous scientific studies assessing the policy requirements for a successful transition away from fossil fuels. Instead of front-loading the EU's efforts in tackling climate change, as recently as 2018 the Commission's assessment was that relying on current policies for the next decade would be a sufficient approach to climate policy. With the public's steadily increasing awareness and consistently dire warnings from the scientific community, the European Green Deal and the Fit for 55 package constitute at least a partial shift away from the previous approach of the Commission as they reflect an increase in ambition as discussed in the previous section. The updated impact assessment of the FF55 strategy based on the Commission's model suite[10] concluded that the EU27 face an annual investment gap of €108 billion over the 2021 to 2030 decade.[11] These are additional investments required in the total energy system (including the transport sector) to achieve the goal of a GHG emissions reduction of -55 percent compared to 1990 levels and a 40 percent share of renewables in energy production as well as a 40 percent improvement in energy efficiency. Over the two decades from 2031 to 2050, however, the Commission estimates that the additional investment spending requirements will fall to €215 billion in 2015 prices, due to the increased efforts in the previous decade. Table 2 provides an overview that compares the Commission's modelling of investment requirements in relation to the CPfA and FF55 strategies.

Table 3: EU total energy system investment gap decomposition

	Investment in total energy system (billion euros, 2015 prices)	2011-2020 average	2021-2030 average	2031-2050 average
(1)	Historic annual investment	683		
(2)	Annual investment baseline scenario (Ff55)		947	981
(3)	Annual investment policy scenario (Ff55)		1,055	1,196
= (2) - (1)	Gap between baseline and historic trend		264	298
= (3) - (2)	Gap between policy and baseline		108	215
= (3) - (1)	Gap between policy and historic trend		371	513

Source: SWD (2020) Table 46. The policy scenario depicted here is ALLBNK which includes emissions from international shipping and aviation.

The final three rows of Table 2 compare the CPfA scenario with the equivalent FF55 scenario over the entire period 2021-2050. The Commission's modelling approach suggests that front-loading of measures under FF55 leads to an overall reduced investment requirement over the entire period (not annually). The total investment of €34,467 billion under FF55 is less, compared to €35,581 billion under CPfA, both in 2015 prices. Excluding the transport sector, this reduces the investment requirement under the FF55 scenario

10 SWD (2020) 176 final – Impact Assessment Part 2/2. Section 9.3.1.1.
11 SWD (2020) 176 final – Impact Assessment Part 2/2. Table 46, BSL minus ALLBNK.

to €13,743 billion which includes €8,102 billion for residential buildings and buildings used in the tertiary sector.

Table 2 compares a policy scenario with a baseline scenario and reports the difference between the two as an investment gap. While these calculations are useful, they depend heavily on the assumptions which went into the baseline scenario and thus the assumption about how effective the current policy framework will be in going forward. Thus, sometimes it is more useful to calculate investment gaps as the difference between historic investment rates and a policy scenario, as in Table 3. The difference between row (3) and row (2) reproduces the average annual investment gap between the baseline and policy scenario based on the Fit for 55 impact assessment (SWD 2020), which is also reported in Table 2. However, in addition, the difference between row (3) and row (1) contains a new investment gap of €371 billion annually between 2021 and 2030 and €513 billion annually between 2031 and 2050 for the total energy system. We will use these gaps between historic investment rates and required investment rates under a given policy scenario to put the Commission's estimates into context in the next section.

2.3 The EGD's investment requirements in context

While the FF55 strategy has made limited improvements on the EU's GHG targets, recent scientific evidence concludes that in order to stay below 1.5°C, more ambitious action is required. The reason is that the EU's Paris-compliant *energy-only* carbon budget is estimated to lie between 21 and 27 $GtCO_2$ (from 2020 onwards), allowing nine years at most at current emissions. Staying within this budget would equate to annual emission reduction rates of 10 percent by 2025 and they would need to increase to 20 percent by 2030. Energy production (across all sectors; see Appendix, Table 10) would need to be zero carbon by 2035-2040 (Anderson and Stoddard 2020). This implies that by 2030 GHG emissions need to be reduced by 65 percent (Wildauer et al 2020) (note that electricity production is not equal to energy production, Table 10). Overall, while FF55 represents an increase in the EU's climate ambitions, taking the Paris Agreement seriously requires further action.

Taking this into account, a 2020 FEPS policy study estimated that over the course of the 2020-2050 period a **Paris-compliant policy path requires investments between €11,670 billion and €16,320 billion annually in excess of historic investment rates, excluding the transport sector** (Wildauer et al 2020). **The bulk of these additional expenditures, namely €7,600 billion to €12,250 billion, are required to insulate the EU's residential and non-residential building stock** and to decarbonise heating and cooling of these buildings. The **next biggest area of investment spending is research and development required to decarbonise industrial processes**. A comparison with the current EU target of spending 3 percent of GDP on research and development (R&D) provides a valuable yardstick. Currently the EU does not achieve this target and since these targets were set in 2010 with much less ambitious climate targets, a 4 percent target seems more realistic. **Hitting the 4 percent R&D target over the 2020-2030 period would require an additional €2,010 billion of R&D investment over the next decade.** When it comes to electricity production, the EU's current strategy of relying on a competitive electricity market to decarbonise by itself within the next decade is doomed to fail, given the performance of the last two decades. Currently, the energy sector replaces about 4 percent of its non-R&D capital stock. More than doubling this rate to 9 percent would allow for a **swift replacement and expansion of the current energy infrastructure**

Table 4: Comparing investment gap estimates

Panel A: Wildauer, Leitch and Kapeller (2020)				
Source	**2021-2050 aggregate**	**Historic investment rates**	**Investment requirements**	**Gap**
EC (2019)	Residential and commercial I	6,125	18,375	12,250
National Accounts	Residential and commercial II	22,600	30,200	7,600
National Accounts	Energy	1,005	2,265	1,260
National Accounts	Industry	2,100	2,900	800
National Accounts	R&D	3,020	5,030	2,010
	Total (residential I)	**12,250**	**28,570**	**16,320**
	Total (residential II)	**28,725**	**40,395**	**11,670**
Panel B: Fit for 55				
Source	**2021-2050 aggregate**	**Historic investment rates**	**Policy scenario**	**Gap**
SWD (2020) 176, Table 46	Power grid	720	2,207	1,487
	Power plants	927	2,304	1,377
	Boilers	54	74	20
	New fuels prod. and dist.		540	540
	Industrial sector	270	515	245
	Residential sector	2,511	5,453	2,942
	Tertiary sector	1,251	2,649	1,398
	Transport sector	14,766	20,723	5,957
	Total energy system	20,499	34,467	13,968
	Total excluding transport	**5,733**	**13,743**	**8,010**

Note: The 30-year outlays from FT55 are compared with the Wildauer et al (2020) data which is converted from an annual average to a total programme outlay where: Residential and commercial I (25 years), Residential and commercial I (20 years), Energy (15 years), Industry (10 years) and R&D (10 years).

to decarbonise energy production by 2035-2040. This requires additional total investment spending of €1,260 billion over the next 15 years. Finally increasing **investment spending in the manufacturing and mining sector** by 3 percentage points to 11 percent of the existing capital stock annually in order to implement carbon neutral processes and technologies **amounts to an additional €800 billion over the next decade**. The underlying logic is to heavily front-load climate investment in the upcoming decade instead of postponing most action to the 2031 to 2050 period. These calculations are summarised in panel A of Table 4 and a detailed discussion can be found in Wildauer, Leitch and Kapeller (2020).

Panel B of Table 3[12] contains the investment gap based on the Fit for 55 strategy relative to historic investment rates. This way of defining

12 See Table 3 in the previous section.

the investment gap is useful for two reasons. First, it makes them more directly comparable to the figures reported in panel A. Second, the estimated gap is independent of assumptions about which actions are likely happen in the near future due to current policies and thus is not affected by an overly optimistic policy outlook. The total investment gap as well as the individual components exhibit substantial differences between panels A and B. These differences come down to three main reasons:

- First, the Fit for 55 strategy is less ambitious than the estimates based on Wildauer et al (2020). The latter are calculated with the aim of reducing emissions by 65% by 2030. This higher ambition requires more investments. This point is especially important in the building sector. Wildauer et al (2020) base their calculations on a threefold increase of current efforts (either based on the annual energy saving rate achieved due to renovations or overall investment spending). In contrast the Fit for 55 impact assessment modelling only implies a modest increase of average annual the energy saving rate in the residential sector to 1.1 percent, and to 0.3 percent in the service sector.[13] In addition, the latter estimates are calculated without the assumed reliance on carbon removal technologies which again implies steeper emissions cuts which translate into higher investment requirements.
- Second, methodological differences. For example, investment estimates for the building sector from EC (2019) are based on the floor space, energy efficiency and renovation costs of the existing building stock whereas estimates in SWD (2020) are model-based.
- Third, panel A explicitly takes investment in research and development into account, which the Fit for 55 impact assessment did not.

Overall, the comparison to historic averages highlights that the additional investment needs in the EU are substantial. The Commission's own estimates amount to €8,010 billion over the next 30 years or €266 billion annually on average. Wildauer et al (2020) estimate a total investment requirement of between €11,670 billion and €16,320 billion; however, over a shorter time period (heavily focused on the next 10 years) and thus averaging between €745 and €855 billion annually. In addition, the reported differences in investment gap estimates do not only stem from differences in ambition, but also from differences in how speedily action is taken.

2.4 Closing the gap

The next two sections discuss how the identified green investment gap can be funded and closed. Section 3 discusses the revenue potential of a European wealth tax and Section 4 discusses the impact on economic growth and public finances of a large-scale public investment initiative funded by issuing government bonds. Both approaches are fundamentally different compared to the FF55 strategy in their focus on the direct provision of critical green infrastructure by governments. Focusing on direct provision has the advantage that concrete plans for the scale and timing can be developed and implemented instead of overly relying on a highly uncertain and volatile carbon price path[14] to incentivise private actors to put the required infrastructure in place. In addition, a long-term plan and strategy provides the private sector with clear signals and a

13 SWD (2020) 176, part 2, Figure 51.
14 See Figure 2 in the Appendix.

pathway which they can incorporate into their own actions and plans. After all, businesses want certainty. Furthermore, the more carbon prices start to bite, the more political pressure there will be to change course and increase the number of permits in European carbon markets, which would bring down prices and ease the pressure on firms and households to act. The existential crisis humanity and the EU is facing in the form of climate change requires serious consideration of all available options. Direct provision of green infrastructure should certainly be one of them. Lastly, while Section 2.3 identified large investment gaps, this does not imply that the entire gap has to be plugged via government funds. For example, homeowners will have to bear a significant proportion of the costs of insulating their homes and electrifying their heating and cooling efforts in order to meet increased regulatory standards.

3. A European wealth tax to fund green investments

Raising taxes to fund the required investments to achieve a carbon neutral economy by 2050 provides a fast and effective solution to the existing funding gap. The question of which taxes should be used to generate these additional revenues is trickier, especially since the EU is also facing the challenges of COVID and currently inflation rates in excess of nominal wage growth, squeezing incomes of low- and middle-income households. A wealth tax would tick three important boxes. First, it can be designed such that it only affects the most affluent part of the population. This means the broadest shoulders in society who can afford to contribute would do so. Second, it is a potent source of revenues which would plug a substantial part of the existing green funding gap. Third, a wealth tax yields additional benefits beyond pure revenue generation.

A progressive wealth tax can be used to reduce current extremely high levels of wealth concentration in the EU which are threatening not only social cohesion but also the democratic process itself. In addition, the infrastructure required to administer a wealth tax would be a powerful weapon in the fight against corruption and organised crime at home and abroad. In the FEPS policy study *A European wealth tax for a fair and green recovery* (Kapeller et al 2020), a detailed proposal including revenue estimations is presented. The remaining section summarises the key points, while the full study is available online and includes a detailed country-by-country appendix.

3.1 The distribution of wealth in the European Union

Currently the most detailed information about the distribution of household wealth in the EU is provided by the *Household Finance and Consumption Survey* (HFCS). The HFCS is a large-scale household survey co-ordinated by the European Central Bank (ECB) and administered by national central banks, covering 22 EU countries.[15] The survey provides information about the distribution of household net wealth, that is the total sum of a household's assets minus the total sum of all outstanding liabilities.

The following discussion will use *wealth* and *net*

15 Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, and Spain.

wealth as synonyms and explicitly use the term gross wealth when referring to the total sum of assets.

The HFCS data shows that household wealth is highly concentrated among the wealthiest households in the EU22. Table 5 shows that total household wealth in the EU22 amounts to more than €35,000 billion. The richest 1 percent of households own 18 percent of that, which means statistically that the average top 1 percent household has a net worth of €3.9 million.[16]

Table 5: Wealth distribution in Europe and selected countries

	Raw survey data			Pareto model		
	Total wealth (€bn)	**Top 1% share (% of total wealth)**	**Billionaires**	**Total wealth (€bn)**	**Top 1% share (% of total wealth)**	**Billionaires**
Germany*	9,394	19%	0	12,520	38%	211
Spain*	4,568	20%	0	4,649	21%	8
France*	7,097	17%	0	8,207	28%	79
Italy*	5,468	12%	0	6,787	27%	57
Poland	1,278	14%	0	1,641	33%	0
EU22	**35,713**	**18%**	**0**	**43,629**	**32%**	**461**

* Rich-list information was available and used to fit the Pareto tail. Sources: *Household Finance and Consumption Survey* and authors' calculations. See full Table in Kapeller et al (2020) .

While this already shows that a small minority is controlling vast amounts of wealth, these numbers almost certainly underestimate the concentration at the top. It is well known from decades of empirical research on the distribution of wealth, and in particular the use of household surveys to measure it, that rich households are less willing to participate in such surveys and thus are under-represented (Kennickell et al 2021). One way of dealing with this problem

16 See the appendix of the original study for a detailed breakdown of the wealth distribution.

is to use a statistical model to estimate the unobserved wealth in the tail of the wealth distribution. The standard approach to this in the scientific literature is to fit a so-called Pareto distribution to the data. The important feature of the Pareto distribution is that it is a heavy-tailed distribution, which in this context means it is a distribution in which extreme values (ie billionaires) exist. A feature which a normal distribution, for example, lacks. Therefore Table 5 also contains estimates after that Pareto correction. Total household wealth in the EU22 increases to more than €43,000 billion and the richest 1 percent own 32 percent of that wealth. This means the average top 1 percent household has a net worth of €8.2 million. In contrast, the poorest 50 percent of the population only hold 4.5 percent of total net wealth.

Table 5 also contains the number of billionaires. Here it becomes clear that the raw data seriously underestimates the amount of wealth concentrated at the top. If the raw survey data were taken for granted, there would be no billionaires in the EU. This is in stark contrast to an estimated number of 431 billionaires which appear on journalists' rich lists such as Forbes' *The World's Billionaires* or *Manager Magazin*'s *Die reichsten Deutschen*. After the Pareto correction the data contains 461 billionaires which is well in line with journalists' estimates, who often interpret their estimates as at the lower end.

3.2 The revenue potential of a European wealth tax

In the past, wealth taxes in Europe often featured relatively low minimum wealth thresholds which extended to larger shares of the population. This led to the introduction of numerous exemptions on primary residences, motor vehicles and many other assets, enabling tax specialists to find loopholes and thinning out the tax base. To avoid these problems from the past, economists are calling for wealth taxes with high exemption thresholds which would only affect the richest part of the population (Saez and Zucman 2022). The estimates presented below incorporate this argument. In addition, revenue estimations for four different tax models are presented. The models differ in their design and how much weight they put on pure revenue generation versus actively reducing wealth inequality. Table 6 summarises their main design features and differences.

Model I (flat tax) serves as a simple baseline. It exhibits a constant tax rate of 2 percent, starting for net wealth holdings above €1 million. This €1 million threshold leaves 97 percent of the population exempt. The constant tax rate means that a billionaire household is taxed in the same way as a millionaire household. This flat tax structure means model I is primarily a revenue-generation tool, which is unlikely to reduce the observed levels of wealth inequality. **Model II (mildly progressive)** exhibits a progressive structure which means the tax rate increases with net wealth. A billionaire household faces a higher tax rate than a millionaire household. The tax rate starts at 1 percent on net wealth beyond €1 million, increases to 2 percent beyond €2 million and finally increases to 3 percent on net assets beyond €5 million. The mildly progressive nature of Model II means it might be able to prevent further increases in wealth inequality but most likely will not be progressive enough to reduce current levels of inequality. **Model III (strongly progressive)** also exhibits a progressive structure. However, in contrast to model II, tax rates increase faster and are likely to be close to or above actual rates of return on wealth. In addition, model III starts at a higher threshold: a rate of 2 percent applies to net assets beyond €2 million. See Table 6 for a presentation of all tax brackets. This strongly progressive design is likely to reduce current levels of inequality and contribute to a more

Table 6: Wealth tax designs

	Model I 'flat tax'	Model II 'mildly progressive'	Model III 'strongly progressive'	Model IV 'wealth cap'	
Approach	Flat rate	Progressive rate – slowing growth of inequality	Progressive rate – reducing inequality	Progressive rate – introducing a wealth cap	
% of population exempt	97%	97%	99%	59%	
Tax brackets	**Tax rates**			**Tax brackets**	**Tax rates**
from €1 million €1 million ≈ top 3% or 5.4 million households	2%	1%		0.5 times average wealth	0.1%
from €2 million €2 million ≈ top 1% or 1.9 million households		2%	2%	2 times average wealth	1%
from €5 million € 5 million ≈ top 0.3% or 550,000 households		3%	3%	5 times average wealth	2%
from €10 million €10 million ≈ top 0.1% or 220,000 households			5%	10 times average wealth	5%
from €50 million €50 million ≈ top 0.01% or 23,000 households			7%	100 times average wealth	10%
from €100 million €100 million ≈ top 0.005% or 9,000 households			8%	1,000 times average wealth	60%
from €500 million €500 million ≈ top 0.001% or 1,200 households			10%	10,000 times average wealth	90%

Note: Average wealth in the EU22 is €260,000 (based on Pareto tail amended data). The tax brackets for model IV therefore start at €130,000 (0.5 times average); €520,000 (2 times the average); €1.3 million (5 times the average); €2.6 million (10 times the average); €26 million (100 times the average); €260 million (1,000 times the average); and €2.6 billion (10,000 times the average).

equal distribution of wealth. **Model IV (wealth cap)** represents a fundamentally different approach by introducing an effective maximum level of wealth at 1,000 times the average (€260 million) and by defining tax brackets based on multiples of average wealth. It was proposed by Thomas Piketty (2020). This tax design is expected to sharply reduce current wealth inequality.

The flipside of the highly concentrated wealth distribution in Europe is that a wealth tax benefits from a very large tax base which is concentrated in the hands of relatively few households. This manifests in the revenue estimates we obtain when applying the four tax designs to the HFCS data on European household wealth. Table 7 presents the results for all four models and two different regimes of tax evasion. In the 'evasion' scenario the tax base is reduced in the following manner: real-estate assets by 20 percent; financial assets by 24 percent; directly held

Table 7: Tax revenue statistics for models I to IV

		Survey data + Pareto tail + evasion	Survey data + Pareto tail + strong evasion
Model I	billion € % GDP % Gov revenue	192 1.6% 3.5%	164 1.4% 3.0%
Model II	billion € % GDP % Gov revenue	224 1.9% 4.1%	190 1.6% 3.5%
Model III	billion € % GDP % Gov revenue	357 3.0% 6.6%	303 2.6% 5.6%
Model IV	billion € % GDP % Gov revenue	1,281 10.8% 23.5%	1,081 9.1% 19.9%

Note: Estimated tax revenues for models I to IV, reported in billion € (2017 prices), in % of 2017 GDP and in % of total government revenue for the EU22 (Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, and Spain). The tax bands and the corresponding rates are presented in Table 6.
Source: Kapeller et al (2021a).

companies by 13 percent; and any other assets by 100 percent. The 'strong evasion' scenario simulates a strong evasion reaction by tax subjects and thus double the reduction factors for financial assets (48 percent) and directly held companies (26 percent). **The results can be summarised as follows.**

First, the revenue potential of a European net wealth tax is substantial. At the lower end of our estimates is the flat tax model I combined with strong evasion effects (highlighted in yellow in Table 7). Under these parameters we still expect revenues of €164 billion (1.4 percent of GDP) annually. At the upper end of our estimates is the strongly progressive model III with standard evasion effects (highlighted in green in Table 7). Under these parameters we expect revenues of €357 billion (3 percent of GDP) annually. Different combinations of the assumptions on evasion and the progressivity of the tax design produce estimates in between.

Wealth cap model IV produces fundamentally different results, as is expected due to the much higher tax rates. Estimated revenues are around €1,000 billion, roughly 10 percent of GDP. **Second, how much revenue is raised depends crucially on the design features of the tax.** We find that setting high exemption thresholds, which would significantly simplify the administration by sparing cash-poor but asset-rich households, does not inhibit the revenue potential if paired with a progressive tax structure. Even moderately progressive tax designs have the potential to generate revenues of up to 3 percent of GDP annually, while leaving 99 percent of all households exempt. Currently, the additional annual investment requirements for a timely green transition are approximately 6 percent (€855 billion) of EU GDP per annum. This means that a European wealth tax could raise substantial revenues towards these efforts from those who can most afford it.

4. Fiscal sustainability of publicly funded green investment

One under-explored option to address the EU's substantial green investment gap is to use the public sector to provide this infrastructure and fund it by issuing government bonds. The key advantage of this approach of direct provision is twofold. First, it would enable a fast and effective response to the current infrastructure needs. Simply organising how to build the required projects would deliver results more certainly than relying on the private sector responding to uncertain (carbon price) incentives. Second, a transparently developed long-term plan provides the private sector with the certainty and long horizons needed in order to trigger private investment in research and the expansion of capacity where needed. Knowing which sectors and products are set to expand would provide more clarity and certainty than an uncertain and potentially highly volatile carbon price path[17] as the main steering mechanism. The political debate is heavily skewed against such an approach. A key concern is the affordability and sustainability of issuing large quantities of government bonds to fund public investment. In an attempt to address this concern, a 2021 FEPS policy study analysed the long-term effects on macroeconomic performance and public finances of a large-scale public investment initiative (Wildauer et al 2021). The remainder of this section summarises the main findings.

17 See Figure 2 in the Appendix.

4.1 The economics of government spending

Assessing the impact of an increase in government spending on the economy (and on public finances itself) is a very old and important economic question. The policy debate and the EU's current fiscal framework is firmly rooted in neoclassical economic thinking of the 1980s and 1990s. Back then many economists thought that increasing government spending would only have a limited effect on the overall size of the economy. Fiscal multipliers were seen as being significantly below 1, which means an additional euro of government spending would lead to an expansion of the overall economy of less than the initial euro spent. Small fiscal multipliers imply that fiscal policy is ineffective. An increase in public spending will leave governments with a substantial increase in debt but with little effect on the overall economy. So according to this view, fiscal policy and increasing government spending would lead to increasing debt to GDP ratios which would become unsustainable eventually. This is the justification for focusing on budget discipline and keeping government spending low.

The underlying economic theory which provided these policy conclusions relied on models which consisted of representative agents maximising their utility and profits. There are several reasons why these models yield small government spending multipliers (Farhi and Werning 2016). First, there is a strict government budget constraint which implies that the net present value of the government's primary surplus needs to be equal to some initial level of public debt. What this means is that there is no room for making the explicit decision that the current situation (like the climate crisis) might merit higher debt levels if it makes it, for example, much more likely to limit global warming to 1.5°C above pre-industrial levels. Essentially, higher public spending now needs to be recouped through higher taxes later. Second, most models include a central bank which will react to increased government spending by increasing interest rates and thus kill off some of the onsetting expansion. This is because central banks are modelled as strongly committed to keeping inflation low. Third, the standard models are assuming that households have perfect foresight (so-called rational expectations). The effect of this in combination with the strict budget constraint is that if government spending increases, households anticipate that taxes will increase in the future and reduce their spending now in order to be able to pay higher taxes in the future. Fourth, in the standard model there is no role for the distribution of income or wealth. That means that whether income is generated in the form of wages or profits does not matter for the overall macroeconomic process.

This is a highly stylised and specific way of thinking about how macroeconomic dynamics (in the EU) work. The failed austerity policies in the aftermath of the 2008-2009 financial crisis triggered renewed research interest in the effect of government spending on the economy. Mounting empirical evidence suggested that fiscal multipliers can substantially exceed 1 (Gechert 2015). Neoclassical economists also began to relax some of their key assumptions in order to explain the existence of potentially large multipliers. First, there is now a large body of literature which assesses the effect of government spending when central banks do not counteract fiscal stimulus (or do not want to because of the zero lower bound).[18] Second,

18 The idea is that if an economy requires stimulus but is at the zero lower bound, the central bank cannot (easily provide it). In turn if fiscal policy is used instead, the central bank will not react by raising rates since fiscal policy provides the stimulus the central bank could not provide.

relaxing households' ability to predict the future by introducing simple behavioural rules (for example, households spend their current income; so-called hand to mouth consumers). Third, allowing for different propensities to consume along the income distribution (either by introducing imperfect profit offsets or by introducing heterogeneous agents). Relaxing these assumptions means that standard neoclassical models of the macroeconomy can yield multipliers substantially larger than 1.[19] This is very much in line with Post-Keynesian macroeconomic models[20] which see multipliers above 1 as nothing special since they usually do not rely on strict budget constraints, perfect foresight and intertemporal maximisation and put special emphasis on the distribution of income and wealth. However, while the current scientific literature does not see fiscal policy as a limited or ineffective policy tool, the political debate is very much stuck in the economic thinking of the 1980s and 1990s. It is against this background that a 2021 FEPS policy study aimed at providing an empirical answer to the question of the effectiveness and sustainability of government spending (Wildauer et al 2021).

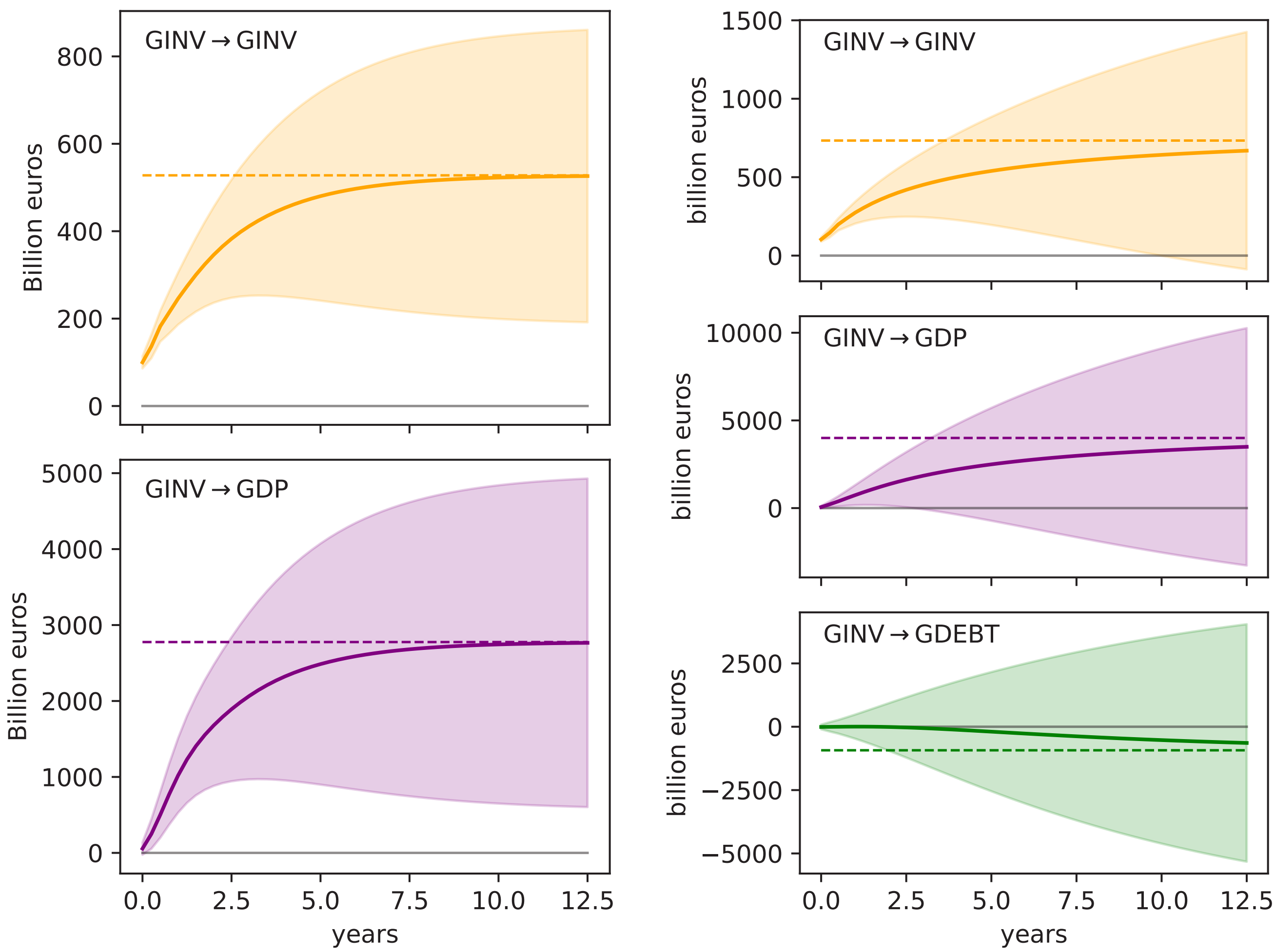
4.2 The long-term effects of a public European investment initiative

The FEPS policy study *Is a €10 trillion European climate investment initiative fiscally sustainable?* (Wildauer et al 2021) estimates the impact that a public investment initiative to shape the climate transition is likely to have on economic growth and government budgets and public debt. The question at hand is whether a large-scale expansion of public investment spending in response to the climate crisis poses a threat to public finances. Using standard semi-structural vector autoregressions (SVAR) models, the size of these effects is estimated using data for the EU27 and its member states. The analysis starts with a scenario in which EU27 governments increase public investment spending by €100 billion above their baseline trajectory. The baseline trajectory is the trajectory of the economy without an exogenous increase in public investment. Figure 1 shows the estimated responses of public investment itself, real GDP and the stock of outstanding public liabilities to such an increase in public investment spending. In model A (left-hand column of Figure 1), an initial increase in government investment (GINV, yellow graph, upper left of Figure 1) of €100 billion beyond the baseline leads to a slow increase in investment spending, which reaches €526 billion 12 years after the initial impulse. This gradual increase in investment spending beyond the initial €100 billion is due to investment projects taking time to implement and most public investment projects are not finished within one quarter. The long-run effect of €526 billion (dashed line) represents the total increase in investment spending over 12 years. That means based on model A, roughly 20 percent of an investment project is therefore spent in the first quarter and the remaining 80 percent is spent over the next decade.[21] To provide some context, public investment spending across the EU27 amounted to €404 billion in 2019. The scenario analysed with Model A thus represents an initial boost of 25 percent of public investment spending, which grows into more than double (+ 132%) the EU27 public investment spending beyond the baseline trajectory ten years after

19 See section 9 in Farhi and Werning (2016) for an exploration of the impact of relaxing these three standard assumptions.
20 See Lavoie (2014) and Hein (2014) for textbook treatments and Dafermos and Nikolaidi (2021), Reissl (2021), Espagne et al (2021) and Onaran et al (2020) for recent examples.
21 €100 billion is roughly 20% of €526 billion.

the initial impulse. The lower left graph in Figure 1 shows the response of GDP to such a public investment impulse. As investment spending increases gradually over time, so does GDP. While the immediate impact is quite small (€57 billion above baseline on impact), the economy expands strongly until GDP reaches an expansion of €2,763 billion (long-run effect, dashed line) beyond the baseline trajectory 12 years after the initial investment impulse.

Figure 1: Long-run effects of investment spending



Note: Solid lines represent responses to a €100 billion increase in public investment. Dashed lines represent the long-run effect, and shaded areas represent 90% confidence intervals. Responses are depicted as deviations from the baseline trajectories.

Model A therefore predicts a strong economic expansion triggered by additional public investment spending. Both the investment responses and those of GDP are statistically significant at the 10 percent level since the confidence band, represented by the shaded area, does not include the zero line. While model A does not explicitly take the government budget into account, the strong expansion of GDP suggests that increasing public investment does not lead to any medium- or long-term problems for public finances. On the contrary, the stronger economic activity is likely to reduce public costs (unemployment payments, furlough schemes) and increase tax and other government revenues. These results are mirrored in model B which explicitly includes the stock of government liabilities. For full details see Wildauer, Leitch and Kapeller (2021).

While the results discussed thus far already provide an idea of the relative size of the investment impulse and the expansion of the economy, it is nevertheless also useful to compare the volume of additional output to the volume of investment spending that leads to this output expansion. A systematic way of carrying out such a comparison is to **compute long-run multipliers (LRMs)** by dividing the increase in GDP x years after the initial investment impulse by the increase in investment x years after the initial increase. These long-run multipliers are reported in Table 8. On impact, which is the quarter in which government investment starts to increase, the multiplier is about 0.56 in both models, which means that in the first quarter additional government investment of €1 would lead to an increase in GDP of €0.56. After one year the multiplier is 4.15 and 2.7 respectively and after ten years, the multiplier is 5.25 in model A and 5.12 in model B. **Ten years after increasing government investment permanently, each additional euro spent on government investment therefore leads to an increase in GDP of €5.25 and €5.12 respectively.**

Altogether these results show that increasing public investment spending in the EU27 leads to a strong economic expansion which in turn increases government revenues and reduces government spending on transfers such as unemployment benefits. This combination leads to an overall improvement in public finances compared to a situation without additional government investment.

Table 8: Long-run multipliers (LRMs)

Horizon	Model A	Model B
Impact (x=0)	0.57	0.56
1 year (x=1)	4.15	2.70
5 years (x=5)	5.18	4.62
10 years (x=10)	5.25	5.12

Note: LRMs are calculated as the ratio of the GDP deviation x years after the investment impulse, relative to the GINV deviation x years after the impulse.

4.3 The benefits of co-ordinated fiscal policy

The conduct of fiscal policy in the EU27 is characterised by the unique situation that the bulk of spending decisions are taken on a national level. For example, the EU budget stands currently at 1.9 percent of GDP compared to 22 percent of GDP for the US federal budget. This means that co-ordinating a large-scale investment initiative is not only paramount due to the EU-wide nature of many projects (for example, transport and energy networks) but also because of the potential for serious costs of co--ordination failure. In order to assess the costs of coordination failure (or the benefits of successful co-ordination), Table 9 compares the long-run multipliers from model A for the EU27 with averaged long-run multipliers obtained from estimating model A for each of the 27 member countries. Column (1) in Table 9 reproduces the long-run multiplier for the EU27 from Section 5.2, which can be interpreted as a measure of co-ordinated fiscal policy since it is estimated from variations in government investment spending across the EU27. Column (2) of Table 9 contains a GDP-weighted average over 20 EU country-specific long-run multipliers obtained from single country models.[22] We interpret these as a measure of the effectiveness of uncoordinated fiscal policy since they are obtained from variations in individual country investment spending only. The averaging of the individual country results condenses the 20 country-specific multipliers into a single number which can easily be compared with the co-ordinated fiscal policy baseline in column (1).

Table 9: Investment multipliers (Model A)

Horizon	(1) EU27 investment impulse (EU27 data)	(2) Individual country investment impulse (GDP-weighted average)
Impact	0.57	1.13
1 year	4.15	2.99
5 years	5.18	3.64
10 years	5.25	3.71

22 Seven countries were excluded from the average because they failed to pass standard statistical specification tests for residual autocorrelation and unit roots. These are: Bulgaria, Greece, Latvia, Romania, Slovakia, Slovenia and Spain.

The results in Table 9 show that the **uncoordinated fiscal policy multipliers in column (2) are consistently smaller than the multipliers based on simultaneous or co-ordinated government investment impulses reported in column (1)**. The differences are large. After ten years, an additional euro of public investment spending generates €5.25 in additional output in the co-ordinated case but only €3.71 of additional output in the uncoordinated case. It is no coincidence that the uncoordinated (average) multiplier is similar to multipliers reported in the literature for individual countries. Estimating fiscal multipliers for individual European countries ignores the benefits from co-ordinated fiscal action. **The results in Table 9 demonstrate the significant benefits of fiscal policy co-ordination in an integrated economy like the European Union.** Already large multipliers of public investment tend to become even larger if public investment is increased as part of a co-ordinated fiscal effort. This is an important lesson not only for the task of tackling the climate crisis but also for fiscal policy in Europe in general.

Conclusion

Climate change remains humanity's most important challenge and time is running out. Under current policies the world is en route to an increase in global surface temperatures of 2.7°C by the end of the century. The EU's current climate policies would only achieve a GHG reduction of 62 percent compared to 1990 levels by 2050, a long way off the crucial target of global net zero emissions by 2050. The European Commission recognises that more needs to be done and presented the European Green Deal together with the Fit for 55 package of legislative proposals in 2019 and 2021 respectively. These policies are designed to bring EU emissions down to net zero by 2050.

This policy brief argues that despite the increased ambition, the FF55 strategy is unlikely to result in either the EU or the world collectively reaching the 2050 net zero target. This is due to three shortcomings of FF55. **First, key modelling assumptions in the Commission's impact assessment, especially about the required deep renovation rates of residential and commercial buildings are unrealistically low** and contradict existing research. FF55 also relies on highly uncertain carbon removal technologies and is somewhat dogmatically primarily based on incentives for the private sector instead of direct provision of required infrastructure. **Second, the timeline of FF55 needs to be reconsidered in light of the global dimension of the efforts to mitigate climate change.** It is naive to think that the global requirement of net zero can be achieved by all countries at the same time, independent of their income level and thus the resources at their disposal. As one of the richest regions the EU will have to give concessions to middle- and low-income countries and become carbon neutral before 2050 in order to give poorer nations additional time and keep the global net zero target for 2050 in reach. **Third, the complexity of the global climate system implies that climate model predictions exhibit a substantial amount of uncertainty.** This means even if the world manages to become carbon neutral by 2050, this might not be enough to limit global warming to 1.5°C, in line with the Paris Agreement. Given the high stakes, it is advisable to err on the side of caution and aim to achieve net zero before the last possible moment.

This means the EGD's ambition needs to be fundamentally increased. This policy brief focuses on the expenditures in green infrastructure neccessary for the EU to achieve net zero before 2050. We estimate that the FF55 strategy suffers from an investment gap (shortfall) of between €11,670 billion and €16,320 billion over the 2020 to 2050 period.

Two policies are especially feasible to increase public investment spending for green infrastructure in the EU. **The introduction of a European Wealth Tax would not only yield revenues between €164 and €357 billion annually**, but would also help to reduce extreme levels of inequality and – with the necessary administrative infrastructure – boost the fight against corruption and organised crime. **Issuing government bonds would also be a viable option to fund green infrastructure spending. Given long-run investment multipliers of about 5**, based on a co-ordinated fiscal expansion, public finances would remain solid and even improve in response to an expansion of public investment expenditures. This means public green investment does not only provide a powerful tool to fight climate change fast and effectively, but also represents good economic policy.

Altogether, the unprecedented challenge of climate change requires policymakers to consider all options and tools at their disposal. The war in Ukraine shows that almost anything is possible if it suddenly is deemed necessary: the surprise announcement of additional German military spending as well as the United Kingdom's sudden urge to get more serious about dirty money in its financial system are but two examples. It is time to recognise the necessity of decisive climate action.

Appendix

Table 10: EU greenhouse gas emissions

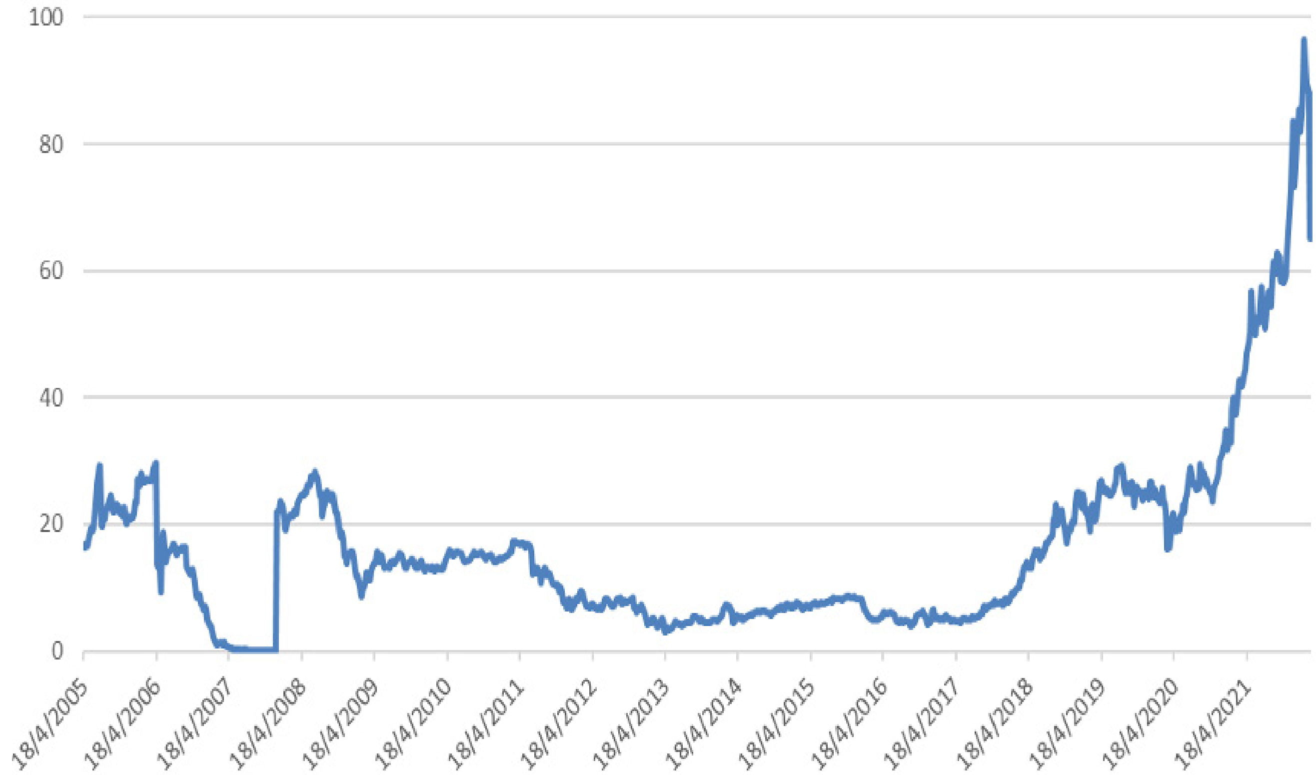
Sectoral decomposition of emissions (percentage of total EU 27 GHG emissions)		
1	**Energy production**	78%
1.1	Fuel combustion in energy industries	23%
1.2	Fuel combustion in road transport	20%
1.3	Fuel combustion by households	8%
1.4	Fuel combustion in manufacturing and construction	11%
1.5	Other energy[23]	15%
2	**Industrial processes and product use**	9%
3	**Agriculture**	10%
4	**Waste management**	3%
		100%

Note: Excluding land use, land use change and forestry and biomass.
Source: Eurostat [env_air_gge] and European Environment Agency. Values are for 2019, the most recent available at the time of publication.

23 'Other energy' includes all other items under energy including international aviation and shipping.

Appendix (cont.)

Figure 2: Price of EU emissions allowances in € per tonne of carbon



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