Global Climate Forum

Working Paper 1/2020

About the European Green Deal

Key Numbers and Mechanisms

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Abstract With the personnel change at the top of both the European Commission and the European Central Bank, a Green Deal for Europe has been put on the agenda. To be politically feasible and socially acceptable, the European Green Deal needs to reduce not only emissions but also unemployment – especially youth unemployment – and regional as well as social inequality throughout Europe. This is possible if the Green Deal shifts the EU economy to a new development path. To provide an example showing feasibility, our paper presents a structure for the Green Deal based on large scale additional investments, in the order of 1% of GDP annually. It outlines how these can be funded, and estimates effects in terms of reaching the goals. An essential point is that the resources must be used in such a way as to trigger a renewal of the European innovation system; while being a challenge, the European Green Deal can thus also become an opportunity – and may be the only opportunity – to reach a carbon neutral European economy by 2050 and to revert the trend of decreasing social cohesion in Europe much earlier.

1 Introduction

In May 2019, European elections yielded a remarkable success for the European Green Party. Later that year, Christine Lagarde became president of the ECB and Ursula von der Leyen President of the European Commission. Both pointed out climate change in the priorities for their mandates. Lagarde stated that in the future the ECB will have to pursue price stability so as to help shifting the European economy from its present sluggish and unsustainable growth path towards a sustainable one. In particular, the ECB should gradually eliminate carbon assets from its portfolio and increasingly invest in green bonds.[1]

The European Green Deal has been outlined in von der Leyen's agenda for Europe (2019) as one of six headline ambitions, and an initial roadmap of key policies and measures has been presented (European Commission, 2019b), and endorsed by the Council in December 2019.[2] It involves

- more ambitious targets of 50%, towards 55%, emissions reductions of the European Union by 2030, and making Europe the first climate-neutral continent by 2050; including a carbon border adjustment mechanism for selected sectors
- designing transformative policies in the fields of energy (clean, affordable, secure), industry (circular economy), building and renovation (energy and resource efficiency), mobility (sustainable and smart), the food system (farm to fork strategy), ecosystems and biodiversity, and zero pollution.

[1] Euractive, *European Central Bank should gradually eliminate carbon assets, Lagarde says*, `https://www.euractiv.com/section/energy-environment/news/european-central-bank-should-gradually-eliminate-carbon-assets-lagarde-says/`, accessed 15 December 2019

[2] European Union, *European Council, 12-13 December 2019* , `https://www.consilium.europa.eu/en/meetings/european-council/2019/12/12-13/`, accessed 18 December 2019

– an estimate of additional investment needs in the order of EUR 260 billion annually up to 2030, and plans to help meet these needs through several mechanisms (a sustainable investment plan, climate mainstreaming in the EU budget, and resources such as the emissions trading system) and a sustainable finance strategy for involving the private sector
– a Just Transition Mechanism (and Fund) for regions and sectors that are most affected by the transition (for this, further regulation has been proposed[3]
– the aim to green national budgets and mobilise research and innovation, as well as activate education and training
– the goal of making the EU a global leader, and
– a European Climate Pact to enable involvement and facilitate commitment of the public and of all stakeholders

Notably, von der Leyen framed carbon neutrality as "the greatest challenge and opportunity of our times" (von der Leyen, 2019). The record of the European Commission in many policy fields since the onset of the global financial crisis in 2007 invites some skepticism as to the capability of the commission to meet this challenge and turn it into an opportunity. However, the strategy announcement by Christine Lagarde pointing in the same direction as von der Leyen changes the picture for two reasons. First, already under the leadership of Mario Draghi the ECB has shown a capability to act in historical proportions: while it has been heavily critized, especially by German voices, there is little doubt that the Eurozone would not have survived without a decisive strategy by the ECB. Second, one should not underestimate the importance of having a German and a French, both with serious European credentials, pursuing complementary strategies at the helm of the Commission and the ECB. Further, another European, Kristalina Georgieva is now managing director of the IMF, and has similarly put climate change on the agenda of her institution.[4]

Grounded in a line of work that has previously considered climate policy not only as a challenge but also as an opportunity for Europe (Jaeger et al, 2011, 2012, 2015), this paper outlines and discusses a decisive and inclusive climate strategy for Europe – in other words, a European Green Deal that is up to the challenge. Such a strategy can be realised only if it will shift the European economy to a new development path that will find broad social and political support. It is therefore the aim of this paper to provide an example which shows the feasibility of such a shift. The example is by no means intended as the only feasible option, let alone as a plan for the coming decade – it presents elements for discussion in designing the European Green Deal.

Section 2 sketches the goals (beyond emission reductions alone) that a European Green Deal (EGD) will need to fulfill to this end. Large scale investments are a crucial element needed for fast decarbonisation; in Section 3, a structure for a decisive and inclusive climate strategy for Europe is outlined. Section 4 discusses options for financing the deal, and Section 5 details the expenditure profile. Then, Section 6 discusses resulting expected effects in view of the goals set in Section 2. Finally, Section 7 presents an outlook on possible ways to move forward.

2 Measurable Goals for a European Green Deal

Attempts to implement decisive climate policy goals are likely to generate fierce resistance. The only way such resistance could realistically be overcome would be if between 2020 and 2050 – and starting early – a new development path generated tangible and widely shared economic and social benefits. In order to consider benefits, first of all, awareness of

[3] European Comission, *European Green Deal Just Transition Fund*, `https://ec.europa.eu/info/law/better-regulation/initiatives/com-2020-22_en`), accessed 17 February 2020

[4] IMF, *Straight Talk - The Adaptive Age*, `https://www.imf.org/external/pubs/ft/fandd/2019/12/climate-change-and-the-age-of-adaptation-georgieva.htm`, accessed 17 February 2020

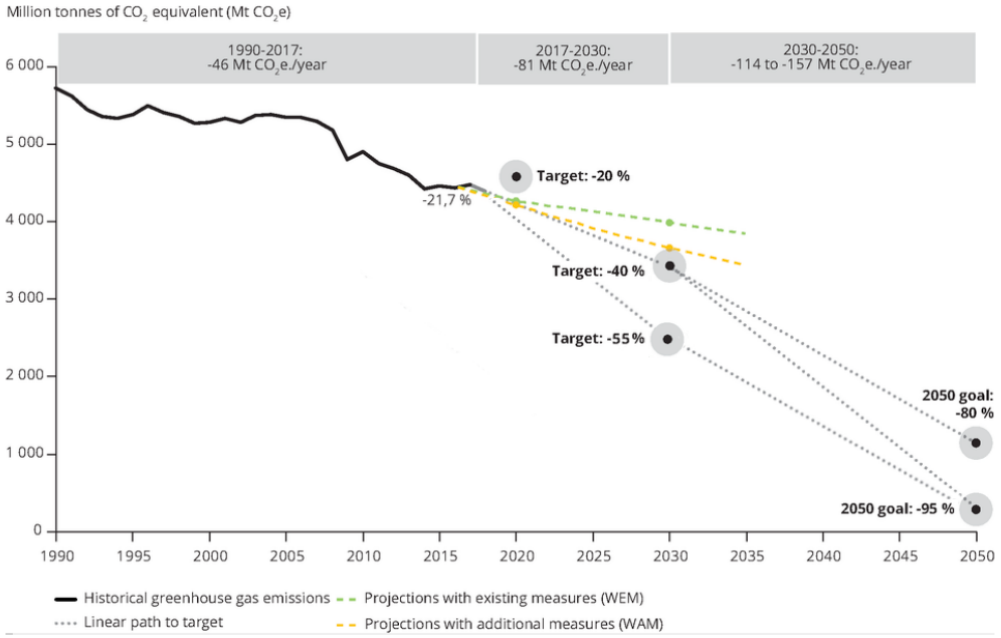

Fig. 1: Greenhouse gas emission trends, projections and targets in the EU. The original figure is from European Environment Agency (2019), the new 2030 target of -55% was added.

the current situation is needed. This section sketches the situation and outlines goals on which a politically feasible path for the period 2020 to 2050 will have to deliver in terms of emission reductions (Section 2.1), of reducing unemployment and inequality in Europe (Section 2.2), of economic growth (Section 2.3) and of price stability (Section 2.4).

2.1 Greenhouse gas emission reductions in line with the declared targets

Against the background of European carbon emissions since 1990, the decarbonisation targets endorsed by von der Leyen are highly ambitious, to say the least (see Figure 1).

Compared to 1990 levels, European emissions have decreased by about 23% by 2018[5], that is, on average about 0.8% of the 1990 value per year, or, considering the compound effect, at an average annual rate of about 0.95%. For the coming decade, however, the European Green Deal's 2030 goal – "to increase the EU's greenhouse gas emission reductions target for 2030 to at least 50% and towards 55% compared with 1990 levels" (European Commission, 2019b) – will require an average decrease of about 5.5% per year[6]. To be politically feasible at all, a massive boost in emissions reductions needs to be achieved early on within this decade. The goal of carbon neutrality in 2050 then implies a decrease in the order of 10% per year for the two decades 2030-2050.[7]

[5] European Comission, *Progress made in cutting emissions*, `https://ec.europa.eu/clima/policies/strategies/progress_en`, accessed 13 December 2019

[6] In line with the figure, and the linear decrease depicted there for simplicity this would correspond to a decrease of about 4% of the current levels (or about 3% of 1990 levels) per year over the the coming decade.

[7] In line with the EU target specifications (and common sense), we allow for a remainder of 5% of the 1990 emissions in 2050. Again, the linear decrease in the figure corresponds to a fixed decrease in each of those years, in this case of 2.5% of current levels (or 2% of 1990 levels).

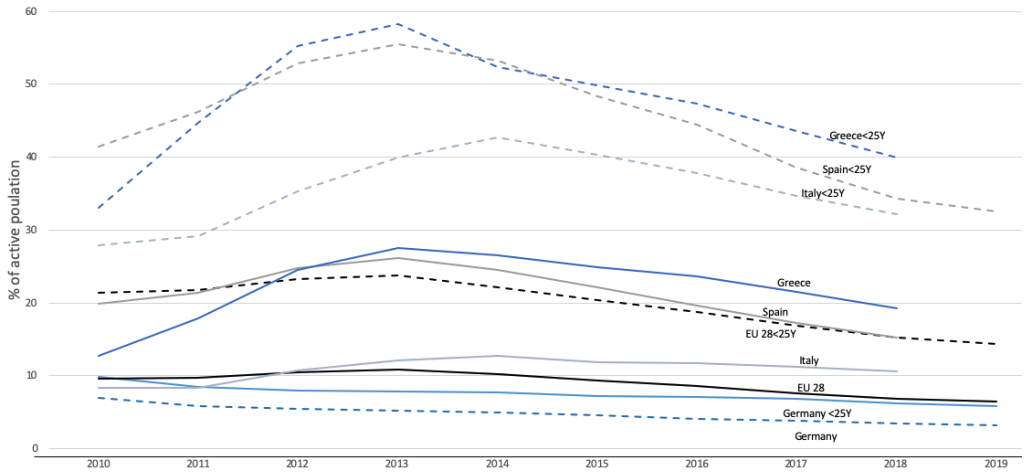

Fig. 2: Rates of Unemployment and Youth (<25Y) Unemployment

2.2 Unemployment below 7%, youth unemployment below 15% across EU nations by 2030

Overall unemployment in the EU has steadily decreased since mid 2013, from a high of 11% to slightly below the pre-crisis low in 2008 of 6.8% (according to figures from the third quarter of 2019, the EU-28 unemployment rate is at 6.3%)[8]. Against this background, an EU wide unemployment rate below 5% does not seem hard to achieve. However, a European Green Deal will not be feasible without addressing the inequality dynamics that is tearing Europe apart.

The unemployment figures for individual countries differ widely, from 2.2% in Czechia, 3.1% in Germany, and 3.2% in Poland to 9.7% in Italy, 14.2% in Spain, and 16.7% in Greece[9]. A sensible goal is to limit national unemployment rates to 7%.

Similarly, while youth unemployment has been decreasing to an overall 14.4%, national numbers differ widely: from 6.2% in Czechia and 6.7% in Germany to 32.2% in Italy, 34.3% in Spain, and 39.9% in Greece[10]. If the EGD is to be experienced and seen as an attractive perspective, by 2030 youth unemployment should be reduced below 15%.

To be politically feasible, a Green Deal needs to address regional unemployment issues with respect to jobs lost due to decarbonisation; not addressing also the regional issues in terms of already existing unemployment, and in particular youth unemployment, would mean missing an opportunity for the European Green Deal. This also implies more appropriate preparations for the risk of a next economic crisis than those undertaken before 2007.

A related issue is reducing income inequality, both in terms of "convergence", i.e., considering differences in GDP per capita between different countries or regions in the EU, and in terms of "cohesion", i.e., income inequality between people within countries. In particular in the second perspective, inequality has been increasing recently, see, e.g. Blanchet et al (2019). As stated by European Parliament President David Sassoli to the World Economic Forum in Davos, the "Green Deal must be an opportunity to fight inequality".[11]

[8] Eurostat, *Unemployment rates, seasonally adjusted*, `https://ec.europa.eu/eurostat/statistics-explained/index.php/Unemployment_statistics#Recent_developments`, accessed 20.01.2020

[9] Ibid.

[10] Ibid.

[11] European Parliament, *Statement by European Parliament President David Sassoli to the World Economic Forum in Davos*, `https://tinyurl.com/sqsqjgv`, accessed 02 February 2020

It is often overlooked that the problems created by the German export surplus for the Eurozone and transatlantic relations cannot and should not be overcome by trying to reduce German exports, but by increasing imports. This in turn can be achieved by higher wages in Germany combined with higher growth across Europe – which is exactly what the European Green Deal can and should achieve.

As a quantitative analysis of these relations would go beyond the scope of this paper, we defer more precise goals for income inequality to further research. However, the unemployment goals stated above already imply a substantial reversal of the inequality dynamics of the last decades. It goes without saying that those goals need to be maintained beyond 2030.

2.3 Average growth rates clearly above 2% up to 2030, above 1.5% up to 2050.

Reducing inequality without accelerating growth would trigger resistance by presently privileged groups, which are among those with the greatest influence on policy-making. Moreover, reducing emissions without accelerating growth would lead countries like China, India, Brazil to postpone major emissions reductions until they may have reached levels of per capita income comparable to those of highly industrialised countries.

The debate about the perspective of a post-growth economy and its environmental advantages becomes really important if one envisages time scales longer than those of the European Green Deal, time scales over which far reaching cultural and institutional innovations may emerge at a global scale. Right now, the challenge is to reduce emissions and inequality while increasing economic growth.

Growth estimates relevant for the decade 2020-2030 point to a range between 1.5% and 2% (Grosand and Alcidi, 2013; European Commission, 2012; PwC, 2017; Knoema, 2019; Trading Economics, 2019). In the years after the financial crisis, growth rates hovered around 2% (European Commission, 2012; Trading Economics, 2019). To generate the necessary political support, the new development path needs to quickly deliver a tangible improvement over the last years, hence the "clearly more than 2%" requirement. Scenarios for the period 2030 to 2050 (one provided by PwC (2017) and a whole range by European Commission (2012)) range from growth rates of 0.8% to about 1.5% p.a. To keep the political momentum, the new development path needs to avoid severe reductions in growth. Hence the relaxed requirement that average growth may – hopefully smoothly – fall, but stay above 1.5% up to 2050.

2.4 Inflation in line with the definition of price stability by the European Central Bank.

A widespread concern with regard to large scale investment programmes like the one envisaged with the European Green Deal is that they will lead to runaway inflation (and, if unchecked, a subsequent crash). Like modern central banks in general, the European Central Bank is committed by law to maintaining price stability. If the European Green Deal threatened this goal, the ECB would raise interest rates and shorten money supply to fulfill its mandate, and the EGD would fail. Therefore, an essential goal of the EGD must be that it is in line with the definition of price stability by the European Central Bank.

The official definition of price stability by the ECB is given by "inflation rates of below, but close to, 2% over the medium term"(European Central Bank, 2019). Inflation rates substantially below 2% are, like high unemployment, one of several possible signals of slack in the economy, indicating that society is wasting resources and that greater output would be possible at no social cost. Moreover, they also signal a danger of serious economic depression that would call for difficult political countermeasures. In the last decade, the average inflation rate[12] in the Eurozone was about 1.68% between 2008 and 2018, see

[12] Eurostat, *HICP - inflation rate*, `https://ec.europa.eu/eurostat/databrowser/view/tec00118/default/table?lang=en`, accessed 02 January 2020

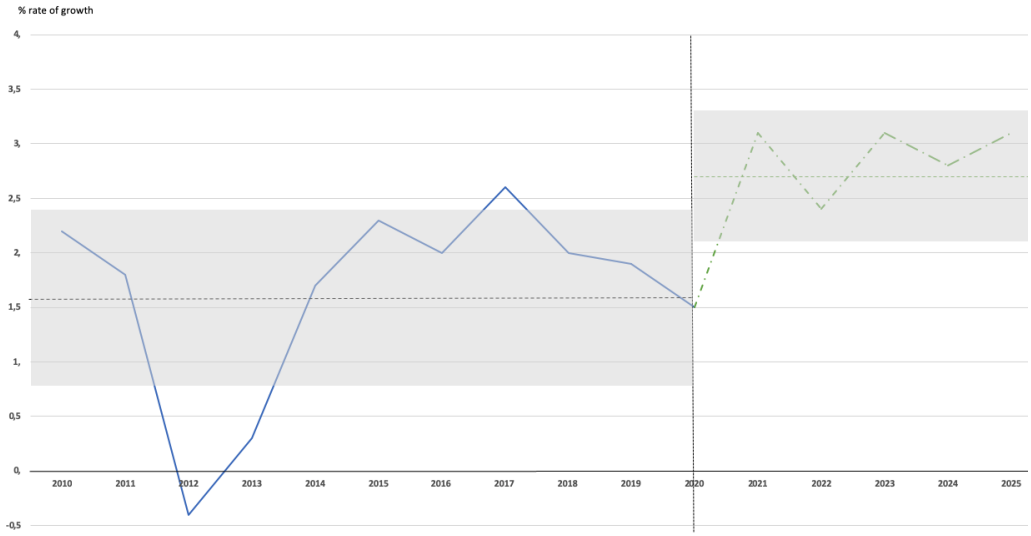

Fig. 3: Real GDP Growth with new path

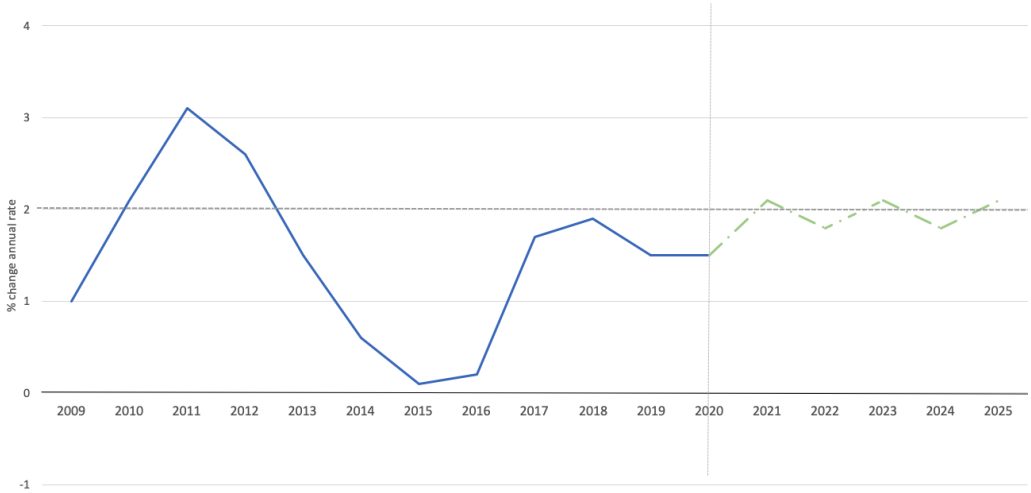

Fig. 4: Inflation (HICP) in the Eurozone with new path

Figure 4. So right now it would be welcome if the EGD made it easier to achieve price stability as defined by the European Central Bank.

On the other end of the spectrum, runaway inflation experiences are well documented at levels higher than 10%, while there is no evidence suggesting that a monetary policy focusing on a stabilization goal of 4% would be problematic, quite the opposite (Ball, 2014). Still, political support for a new development path requires that the ECB can somewhat accelerate the present rate of price increases while making sure that inflation rates of 2% and more are rather exceptional.

3 A Structure for the Deal

Achieving the goals listed in the previous section might be impossible. If so, the vision of a European Green Deal would most likely fade away as one more rhetorical device – and in

2050 Europe would be far from carbon neutral. In the following, however, we want to show that such a deal is in fact possible – although certainly not easy to achieve. In the present section we sketch an annual investment amount and expenditure profile to construct a series of conditions that are technically and economically possible. It would be utterly naive to think that the conditions spelled out in the present section are the one and only way to realize the ambition of the European Green deal. But they give an example of what will be needed for this purpose. Wishful thinking will not work.

As a first condition, consider a substantial stream of additional public investment in the years to come, beginning with annual additional investment in the order of 1% of EU GDP, i.e. about EUR 150 billion.[13] Setting this up will need several months. The German EU Council Presidency in the second half of 2020 offers an opportunity for this process. Against this background, we consider an additional investment stream starting at the beginning of 2021.

The distinction between public and private investment is less clear-cut than is often assumed. For the moment we consider an investment stream triggered by public authorities across Europe. How it will be financed and what role the ECB might play in the process are of course crucial questions, as is the question of what effect such a stream of public investment will have on private investment. This is the topic of Section 4.

To sketch how the public investment stream will actually look like, we consider the following expenditure profile that will then be further discussed in Section 5.

- 50% on energetic renovation of the building stock
- 20% on adaptive green infrastructure
- 20% on advanced education for green vocational skills
- 5% for R&D in IT-related decarbonisation
- 5% for subcontracting management tasks for implementing the Green Deal

In Section 6, we will then argue that the conditions outlined indeed lead to fulfillment of the goals.

After 2021, the Deal should evolve so as to reach the benchmarks. In line with the agility envisaged by Lagarde for the ECB[14], this includes continuous monitoring, engaging in reflections for understanding relevant dynamics "with an open mind and dedication", and a forward-looking perspective on the broader context of the given policy strategy.

4 Financing the European Green Deal

Financing the European Green Deal requires navigating a passage between two dangers. On the one hand, there is the danger of attempting an old school New Deal (a danger so far largely ignored in American discussions about a green new deal). On the other hand there is the danger of trying to solve a challenging, historically new problem by relying only on procedures and institutions that have developed in view of very different tasks.

To tackle the first danger, it is important to understand key facts about the original New Deal. It was realized in the US under the presidency of Franklin D. Roosevelt as a response to the great depression of 1929. His predecessor, Herbert Hoover, had failed to overcome the depression with attempts to keep a balanced budget, along with vetoing bills that would have provided relief to Americans struggling in the crisis. After winning the 1932 presidential election, Roosevelt distinguished between a regular balanced budget and temporary measures to fight the great depression, with the latter implying deficit spending. In parallel, he implemented far-reaching financial regulations, in particular enabling the Federal Reserve System to produce Dollars not covered by gold reserves (while the US would

[13] EU GDP was around EUR 15.8 trn according to Eurostat, *GDP and main components*, `https://tinyurl.com/yfq9oce9`, accessed 08 January 2019

[14] IMF, *Opening Statement by Christine Lagarde to the Economic and Monetary Affairs Committee of the European Parliament*, `https://tinyurl.com/sd2elr5`, accessed 29 December 2019

continue to use gold for the payment of international trade balances). Crucially, Roosevelt always saw the New Deal as a policy to reduce inequality, in particular by strengthening the American Trade Unions, most significantly with the National Labor Relations Act of 1935. The New Deal would never have worked without the constituency of the labour movement.

In 1936, as the economic situation was improving, Roosevelt prematurely tried to balance the overall budget again, triggering a relapse into depression (reminding of the premature 2011 increase of interest rates by the European Central Bank under Trichet). In 1938, Roosevelt understood that his attempt to achieve a balanced budget had been a mistake, and strengthened social programs to assist the poor and jobless. This brought the economy back on a promising track. But full recovery was eventually restored only by the wartime effort, starting in 1940, with the budget deficit increasing all the way to 26.9% of GDP in 1943, with US economic growth staying above 10% until the end of World War II.

Against this background, trying to finance the European Green Deal following the template provided by Roosevelt raises three problems. First and foremost, over the past fifty years the traditional labour movement has been dismantled to such an extent that it is not easy to see how it could provide a key constituency for a "New New Deal". This became painfully clear with the Obama-Geithner Stimulus of 2009, which stopped the great recession by driving the US Budget deficit up to 9.8% of GDP, in combination with regulatory measures. While there were obvious similarities with Roosevelts New Deal, this policy kept Wall Street and the super rich comfortable, while large parts of the working class missed out (Tooze, 2018). In the meantime, in America as in Europe, large parts of the working class have turned away from their traditional political representatives and started supporting new kinds of nationalism.

Second, as mentioned above, the original New Deal was completed with the wartime effort. This led to a new national innovation system in the US, geared to the military-industrial complex. The wartime effort funded a huge amount of innovation processes – in mechanical engineering, electronics, medicine, aerospace, etc. – and it did so in a very important way: it linked government funded R&D to large-scale production activities, and the funding was managed by professionals with outstanding capabilities to understand what the research was about, who the researchers were and what problems they ran into. The last point led to an on-going conversation between funders and researchers, as opposed to the standard administrative controls all too familiar in research funding all over the world. This led to a unique style of fostering R&D, that may be called "funding embedded in conversation". Long after World War II, it led to institutions like DARPA, the Defense Advanced Research Projects Agency. Obviously, DARPA fosters mainly R&D focused on sophisticated weapons and military infrastructure, but is also active in medical research, cognitive science, robotics, and more. Much later, in 2005, funding embedded in conversation was brought to a new terrain by a few silicon-valley-connected people who created forms of venture capitalism that adopted the style of embedding money flows in conversations between highly competent people. A paradigmatic example is the silicon-valley-based Y-combinator. It is a company that defines itself as a a "seed accelerator", investing in startups (occasionally including non-profits), claiming a relatively small fraction of equity, and engaging in an on-going conversation with the startups it invests in. We will come back in a moment to the problem that Europe lacks an innovation system of the required scale.

The third problem for a "New New Deal" approach to the European Green Deal is that in today's European Union, there are explicit rules setting tight limits to such an approach. As is well known, the European Union expects its member states to fulfill, among others, two of the so-called Maastricht criteria: not to run budget deficits higher than 3% of gross domestic product and not let their public debt exceed 60% of GDP. Countries that fail to meet one of these criteria are subject to an "excessive deficit procedure". The procedure is run by the European Commission and the European Council, who have a lot of freedom in how they operate. Members of the Eurozone may have to pay fines, other members of the EU will be subject to shaming, which can still be quite effective, especially as a signal to

financial markets. In any case they have to submit a plan for how they intend to fulfill the criteria in the future.

Surprisingly, perhaps, the overall deficit of EU member states is just 1% of GDP. So at first sight there would still be – forgetting the first two problems mentioned above – scope for financing a European Green Deal through European budget deficits that would keep the EU-wide deficit below 3% of GDP. And one might argue that the EGD would give economic growth a boost such that it will actually be much easier to fulfill the debt criterion of no more than 60% of GDP. But this would run into fierce opposition as it flatly contradicts the spirit of the Maastricht criteria. In particular, Germany has given itself the even stricter constitutional rule that under normal conditions the budget deficit should not exceed 0.35% of GDP.

The upshot is that there is just a little leeway for financing part of the public investment needed for a European Green Deal through modest budget deficit increases – say 0.20%. Presently this would correspond to about 30 of the EUR 150 billion that we have taken as a starting point.

This leads to the second danger, of relying exclusively on institutions and procedures that have developed in view of other tasks. In the present debate, the most promising option for financially launching the European Green Deal is the European Investment Bank (EIB). Currently, the subscribed capital of the EIB is nearly EUR 250 billion. The EIB limits its lending to a gearing rate of 2.5 times the subscribed capital. With a balance sheet total of about EUR 550 billion, current lending is substantially lower than that rate. Presently, the EIB gives new loans within the EU in the order of EUR 50 billion per year; implying that the average duration of a loan is in the order of 10 years – of course with great individual differences.

Of the subscribed capital only EUR 20 billion have actually been paid in. 20 out of the EUR 30 billion that might be mobilised by EU members as an utterly modest deficit spending of 0.20% of GDP (lower even than the German rule of 0.35%) could be paid in to the EIB. They could then be complemented by 100 billion of not paid-in capital, leading to a total subscribed capital of EUR 250+20+100=370 billion, driving the limit for total assets to nearly a trillion, as (250+120)*2.5 = 925. The point of this example is not to provide a plan, but to illustrate a mechanism: with the help of not paid-in, but subscribed capital and the modest gearing rate of 2.5 set by the EIB, EUR 20 billion could be leveraged all the way up to EUR one trillion. Thanks to its triple A rating, the EIB would have little difficulty to raise that amount at interest rates much closer to zero than most governments, let alone companies. This is all the more so if Lagarde's ECB can realize its intention to not only move out of fossil fuels but also to increasingly buy green bonds. von der Leyen's Commission should be able to define a European green bonds standard on which the ECB can rely, and the EIB should be able to fulfill that standard. With an average lifetime of ten years per investment, an additional annual investment of about 100 billion would be feasible – an amount that would increase with economic growth.

This leaves two questions: how to generate the effective demand to make those investments promising? And what about the EUR 50 billion that are still missing compared with our benchmark? As for the first question, keep in mind that we are talking about investments that are supposed to be paid back. And nobody will invest in a million charging stations for electric cars if the demand for the cars to be charged is not in sight. Now this particular demand can be created by regulation. The present regulation for average fleet-wide emissions, including the serious sanctions for companies that miss the targets, are an important step on the right track. And notice that the regulation does not prescribe the use of electric cars – it is up to the companies to decide with which technologies and business models they want to use in order to achieve the targets. In principle, a similar approach can create a thriving market for the much bigger investments in energy efficient refurbishment of buildings. There is a need for creative regulation design, as the housing market has a very different structure from the car market. In both cases, a carbon price is an important signal, but a politically feasible carbon price will not produce the desired ef-

fects in the desired time-frame, so relying on it alone to lead to a fundamental change of the overall infrastructure would take way too long. However, in the case of cars the European parliament has found a remarkably creative regulation, just as the German government found a creative approach in 2004 with the feed-in tariffs for renewable energy in the power grid - an approach that may be used in modified forms for other products as well.

For Europe, however, a key challenge of these approaches is that while they are perfectly appropriate to other tasks, they are not sufficient for Europe's Green Deal. The reason is that they rely on sectoral learning curves by shifting investment from one sector or technology to another. Thereby they change the direction of growth in a desirable way, but they do not address the sluggish growth and regional as well as social inequality that undermine the vitality and possibly the future of Europe.

What is even worse is that the European Union lacks an innovation system with the potential of the American, and increasingly the Chinese one. Before World War I, among the European nations, both Great Britain and Germany, and to some extent France, had thriving national innovation systems. They have not survived the two World Wars. Of course Great Britain still has some of the best universities in the world and when it comes to innovations in finance and finance-related information technology, London is second to no one. Germany still profits from its system of vocational education and has an astonishing ability to continuously improve mature technologies like traditional cars and machine tools (all the way to Computer Numerically Control machines and from there to robots). France has been able early on to catch up with the Japanese high-speed trains and, together with Germany and Britain, to catch up with American aircraft. However, so far the European Union does not have an innovation system capable of large-scale disruptive innovations.

With all due respect for the essential role the European Investment Bank is performing, it's mandate makes it very different from institutions like DARPA or the Y-combinator mentioned above. The European Green Deal cannot be launched and consolidated without the EIB, but the EU will a need to create new structures to achieve the innovation potential without which the European Green Deal cannot succeed. If two thirds of a microscopic EU-wide deficit spending would be amplified through the EIB, then the last third should be used as start capital for a European seed accelerator. This would be a Special Purpose vehicle formed by a few European countries willing to take the lead, and open to let others join. For historical reasons (and in contrast to the incredibly productive innovation system of Germany under Hitler) a European innovation system that will be up to the tasks of the future cannot use a military-industrial complex as its backbone. The European Green Deal offers a unique opportunity for an alternative backbone enabling Europe to play an inspiring role in a global sustainability transition (Mazzucato, 2019).

With great optimism, one may expect the European seed accelerator to amplify the 10 billion of public input all the way to 50 billion, so as to match the benchmark for a growth enhancing European Green Deal. But realism points to the missing piece of lacking effective demand. The fact that even the EIB does not utilize the potential that it has under its self-imposed, low gearing rate of 2.5 does not point, as is often believed, to "a lack of suitable projects" – it points to a lack of effective demand that leads potential investors to shy away from productive investment. High net worth individuals (HNWI: owning more than $1mn) are currently hoarding more than one quarter of their assets in cash, and many corporations are awash with cash as well.

The background of this situation is the fact that in the past decades in industrialized countries, wages have increased much less than productivity (sometimes not at all). HNWI cannot realistically spend all their money on consumption, nor do they usually wish to do so. But profitable investments are not easy to find when wages lag behind productivity, simply because of lacking overall effective demand. Allowing wages to catch up with productivity would improve the situation, allowing everybody to be better off. In particular, solid empirical evidence shows that increasing the minimum wage does not reduce employment, whilst actually increasing productivity.

A complementary measure could be a low taxation of productive investment balanced with a higher taxation of large holdings of cash and cash-like financial assets. This, however, will hardly be realized in the beginning phase of the European Green Deal. Realistically, there needs to be an iterative process of stimulating additional green investment and stepwise increasing effective demand.

5 An expenditure profile

For the expenditure profile outlined above, again, it is important to consider the current situation and trends that build the basis for what is suggested. This section provides more detail on how the money can be invested to foster decarbonisation along with social cohesion in the context of the situation in the proposed fields.

5.1 Renovation of the European building stock

In Europe, there are about 20 billion square meters of residential floor space.[15] Only a tiny fraction of these fulfills reasonable energy efficiency standards: according to the European Commission, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient.[16] This means that almost 15 billion square meters of residential floor space are energy inefficient. Currently, only 0.4-1.2% of the building stock is renovated each year[17], that is, something between 0.08 and 0.24 bn square meters overall. At such a rate, renovating the inefficient European building stock would take at least 60 years, while – just to give an indication of relevant orders of magnitude – renovating all of the inefficient buildings in 30 years (up to 2050) would correspond to an average of half a billion per year, and in 20 years up to 2040, to 0.75 billion m^2 of floor space per year.

In discussions about technical progress, especially in the climate policy domain, it is often assumed that such progress comes automatically once production expands. While there is solid empirical basis for this claim (see, e.g., Nagy et al, 2010), the speed at which this happens depends on many factors. A very important factor for the speed of progress is the national innovation system in which the economic activity is embedded (see Section 4). Generally speaking, the construction industry is not very innovative. However, Europe is home to several of the most important construction and engineering firms of the world. It seems that such a large-scale operation as the energetic refurbishing of the European building stock would offer an opportunity to enhance the European innovation system to the point where the European construction industry could make breakthrough innovations, perhaps related to 3D printing, new materials, nanotechnology, robotics and many more.

This would make the European energy transition much cheaper, open up new market shares in the global construction activities for European companies, and make it attractive for other countries to engage in large-scale emissions reductions from their building stock. To achieve this effect, the European construction industry would need to develop an ecosystem of breakthrough innovations. For this purpose, out of a total budget of EUR 75 billion, 5 billion may be dedicated to the buildup of that ecosystem. E.g., the EU could contribute 50% to venture capital funds set up by large European construction companies. These funds

[15] Non-residential floor space amounts to another 6 bn square meters roughly. However, the energy consumption is very small compared to the residential part (below one percent in 2013, according to European Comission, *EU Building Stock Observatory* . `https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings/eu-bso`, accessed 08 February 2020). Hence we disregard non-residential buildings in the first estimates that this section provides.

[16] European Commission, *Energy performance of buildings directive: Factsheet*, `https://ec.europa.eu/energy/sites/ener/files/documents/buildings_performance_factsheet.pdf`, accessed 17 January 2020

[17] European Commission, *Energy Peformance of buildings directive: Facts and figures*, `https://tinyurl.com/s96zpbd`, accessed 17 January 2020

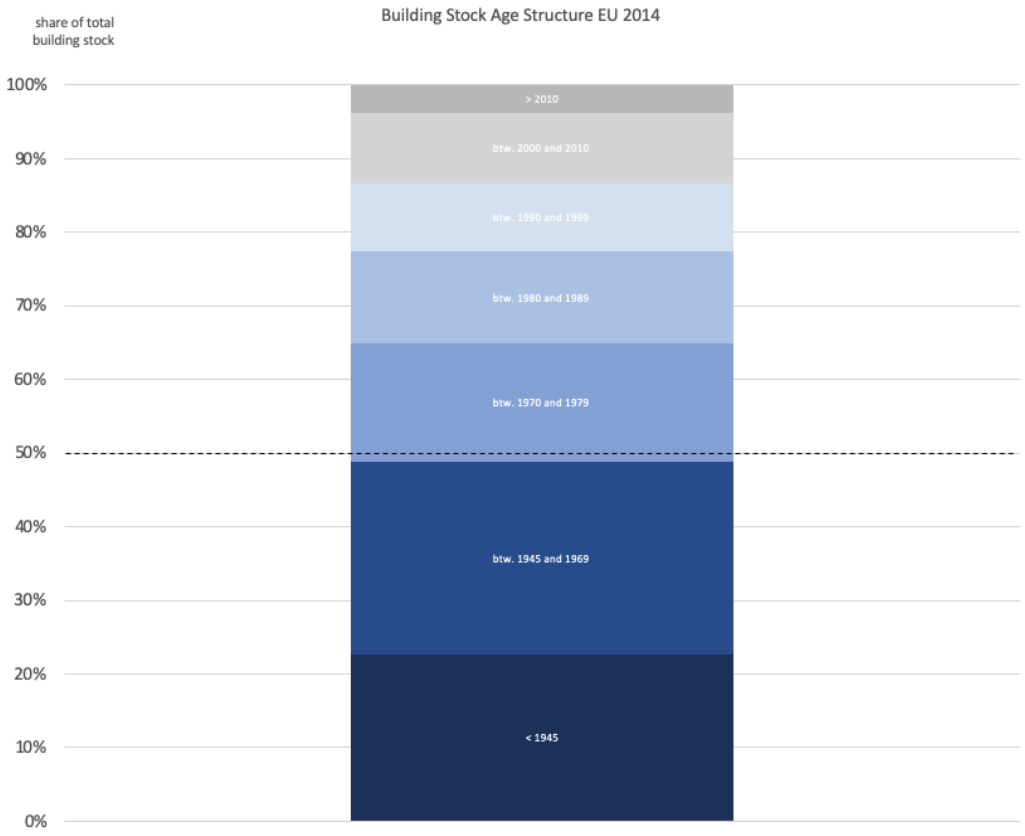

Fig. 5: Age structure of European building stock 2014

would launch startups developing innovations in connection with the energetic refurbishment actually going on. The EU would then get 50% of the profits of the funds. Similar funds could also be set up independently from large companies, involving independent investors, universities, professional associations, etc. It is crucial, and perfectly possible that this ecosystem reaches a critical mass to achieve a vital success for the European Green Deal.

Present estimates of energy renovation costs range from EUR 200 to 450per m^2 depending on the depth of renovation (European Parliament, 2016). With the remaining EUR 70 billion per year for renovating the European building stock, advantageous credits of EUR 100 per square meter could be offered to building owners, that is, between 22% and one half of the renovation costs, thus supporting the renovation of 0.70 bn square meters per year. Later on, successful innovation may allow larger annual shares of buildings renovated.

5.2 Adaptive Green Infrastructure

Infrastructure is not a precise concept, and that needs to be kept in mind when thinking about the European Green Deal. According to some definition, infrastructure investment in Europe was around 2.2% of GDP between 2007 and 2015 (Oxford Economics and Global Infrastructure Hub, 2017). This includes investment relevant for mobility (roads, rail, ports,

and airports), power transmission, and telecommunication, among others. The transport share is in the order of nearly 1% of GDP, with roads the largest fraction[18].

The share of additional public investment to be allocated to infrastructure mentioned above (i.e., 20% of the additional 1% of GDP) corresponds to an additional investment of 0.2% of GDP, or EUR 30 bn, in 2021.[19] Notice that here we focus on additional investment, on top of "green" investment streams due to shifts away from "brown" opportunities. The latter are of course crucial, but they will not generate the macroeconomic effects needed for a European Green Deal to become attractive for a vast majority of citizens of Europe – and for countries like China and the US watching the European experience.

It will be critical to avoid locking the economy into existing or too rigid future structures. Thus, infrastructure investments that foster decarbonisation but leave room for adaptation are needed in a number of areas.

One such element is charging infrastructure for electric vehicles, that, carefully placed, can contribute to decarbonizing motorized individual mobility while accepting that electric vehicles may (and perhaps should) not conquer the whole market. In particular, developments in the adoption of hydrogen technologies may provide a different perspective later on.

Europe currently has around 300 million cars, where only 3.4% of these, i.e. about 10 million, are alternatively-powered passenger cars.[20] Less than one million cars in Europe were electric vehicles in 2017 (International Energy Agency, 2019). According to the European Alternative Fuels Observatory, the current number of (plug-in hybrid and battery) electric vehicles in 2019 was 1.4 million, the remaining 8.5 million being mainly non-plug-in hybrids and natural-gas-driven vehicles. The EU currently has around 193,000 public charging points for electric vehicles, so that the average ratio of EVs to public charging stations is about 7 cars per station[21]. The density of charging infrastructure generally correlates positively with electric vehicle adoption, while the influence of charging infrastructure as a variable seems to differ depending on the national context (European Parliament, 2018).

Adding 400,000 charging points per year[22], an increase of the fleet of electric vehicles by an annual 2.8 million could be supported at the current ratio. Assuming further the current shares of almost 90% normal and only 10% fast charging stations, and costs per charging point of roughly EUR 2,500 (normal) and EUR 70,000 (fast)[23], this corresponds to an investment of almost EUR 3.7 bn.

Infrastructure for biking seems a no-regret option for investing into emission reductions and health. While national numbers are hard to come by, some cities can be drawn upon for a rough estimate: Copenhagen invested more than EUR 35 per person and year into cycling, Amsterdam EUR 11, Berlin was one of the higher ranking German cities with EUR 4.7 per person[24]. While not all European cities can become Copenhagen-like, an investment

[18] European Energy Agency, *Investment in transport infrastructure*, `https://www.eea.europa.eu/data-and-maps/indicators/infrastructure-investments/assessment-3b`, accessed 17 February 2020

[19] For comparison, the "investment need forecast" of the Global Infrastructure Outlook Oxford Economics and Global Infrastructure Hub (2017) considers a share of 2.6% necessary between 2016 and 2040, which would mean an increase of 0.4% of GDP. Which part of infrastructure investment will be privately financed in the years and decades to come remains to be seen.

[20] European Automobile Manufacturers' Association, *Passenger Car Fleet by Fuel Type*, `https://www.acea.be/statistics/tag/category/passenger-car-fleet-by-fuel-type`, accessed 10 February 2020

[21] European Alternative Fuels Observatory, *Infrastructure, Electricity*, `https://www.eafo.eu/electric-vehicle-charging-infrastructure`, accessed 02 February 2020

[22] According to the Commission, two million public charging points could be needed by 2025, assuming 7 % of new vehicles are electric in 2025. European Union (2019)

[23] These numbers are based on Nicholas (2019) considering the middle type of fast chargers.

[24] Greenpeace, *Radfahrende schützen Klimaschutz stärken*, `https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/mobilitaet-expertise-verkehrssicherheit.pdf`, accessed 15 January 2020

of EUR 10 per person for the EU27's about 446 million people[25] would provide annual financing in the order of EUR 4.5 bn for improving mobility by bike.

Similarly, not all European cities can become Vienna-like in terms of public transport, but investment into public transport is another no-regret option. One particular aspect of the public transport system in Vienna is its relatively low price for users (an annual ticket costs a Euro a day), but a longer-term expansion of the public transport system, as well as a simultaneous increase in the price of parking tickets are also important factors. Comprehensive numbers on the investments relating to a successful public transport system are thus hard to come by; the increase in Vienna'a public subsidy of EUR 50 mn in the year when the annual ticket price was reduced (see Sommer and Bieland, 2019) would correspond to about EUR 28 per person, but is certainly only partially indicative. Nevertheless, in analogy to the biking investment, we consider an additional investment of EUR 20 per person in Europe, i.e. EUR 9 bn useful as part of a European Green Deal.

Increasing relevance for walking and biking in European cities is an important example for how decarbonisation can contribute to a better quality of life. Historically, these cities developed long before the auto industry, and the widely recognized beauty of classical European cities gains from car-free zones – as does air quality. That said, even if demographic stagnation limits the growth of the total number of cars in Europe, in the coming years their number will hardly diminish, so that alternative cars will be an important element of the European Green Deal.

Transport of goods is another element that needs infrastructure, where a shift from road to rail is already being envisaged: "in recognition of their social and environmental benefits, the Commission has set a target of shifting 30% of goods transport away from trucks, and onto rail and inland waterways by 2030, and subsequently by 50% by 2050"(Finger et al, 2019). Currently, freight has a road transport share of about 70% (European Commission, 2016), compared to about 17% for rail (Finger et al, 2019) and the total rail infrastructure investments in the EU28 in 2016 were equal to about EUR 32 billion (European Commission, 2019a).

Further, infrastructure investment can foster decarbonisation through power grid expansion; the Ten-Year Network Development Plan of the European Network of Transmission System Operators for Electricity considers EUR 114 bn of proposed investments by 2030, or roughly 11 bn per year (European Network of Transmission System Operators for Electricity, 2019). European Commission (2018a) find projected capital expenditures of EUR 152 bn for electric transmission, i.e. about 15 per year, and 14 bn, i.e. 1.4 per year, for electric storage.

Next, telecommunication infrastructure will have to play a role in digitalisation for decarbonisation, e.g. for smart homes. Capital expenditure in this area is stated to have been EUR 47 bn in 2016 (European Telecommunications Network Operators Association, 2017).

An important new element in infrastructure investment for a European Green Deal concerns hydrogen. In 2004, Romano Prodi, then President of the European Commission, launched the "European Hydrogen and Fuel Cell Technology" Platform[26]. After a while, this came out of fashion, but more recently so-called green hydrogen (and/or methane, methanol etc.) as an energy carrier is back on the agenda, especially as an opportunity to satisfy the energy needs of a decarbonised European industry. Additional public investment in hydrogen technology and infrastructure seems warranted. Europe is lagging in its capacity to bring down the costs of hydrogen technology to levels reached in China (Deutsch and Graf, 2019). Incentives and requirements to get industry on a learning curve by producing more and more hydrogen, especially from renewables, will certainly help (Buck et al, 2019). However, the situation points to a fundamental problem discussed in Sections (5.1) and (4):

[25] Eurostat, *Bevölkerung am 1. Januar*, `https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=de&pcode=tps00001`, accessed 23 January 2020

[26] European Commission, *A strong European technology partnership to move towards the hydrogen economy*, `https://ec.europa.eu/commission/presscorner/detail/en/IP_04_69`, accessed 16 February 2020

how to get the European innovation system to the point where on top of delivering steady enhancements – at world class levels – of established technologies (as with German cars and machine tools) as well as some spectacular catch-up operations (as with the Airbus), it can become one of the leaders in breakthrough technologies, too. The European Green Deal probably is the best, and in the coming years probably the only, opportunity for this. Therefore, to envisage a sum in the order of EUR 3 billion for this purpose seems certainly reasonable.

While concrete numbers need further research in all these fields, a rough sum of annual investments in transport, electricity and telecommunication is in the order of EUR 200bn. While we certainly want to avoid planned-economy style micro-management, considering a sum of EUR 10bn useful to speed up decarbonisation in these sectors is hardly too big a number. Together with the sums mentioned for electric charging stations, biking, public transport, and hydrogen technology, this yields to about EUR 30 bn in 2021 for adaptive green infrastructure.

5.3 Advanced education for green vocational skills

The green stimulus will require rapid advanced training, first and foremost for the construction sector. Costs for education and training vary widely across the EU; for example, annual expenditures on educational institutions per pupil/student based on full time equivalent, excluding early childhood education, range from from about EUR 1,200 in Romania to almost EUR 18,000 in Luxembourg.[27] Also, the share of this expenditure covered by government varies, from almost 100% in Romania to 75% Cyprus (and even slightly below this in the UK).[28]

Employment in construction[29] has been around 15 million persons in 2017. Continuing with an assumption of EUR 7,000, based on the EU27, EUR 10 bn would allow for a year of training for roughly 1.4 mn people. If trainees earn a salary while in schooling, as is customary for the dual system for vocational training, e.g., in Germany, doubling this sum per person would correspond to an average EUR 580 per person per month. For comparison, salaries of apprentices in Germany in the first year of training range from just below EUR 500 (chimney sweep) to just above EUR 1000 (e.g., specific mechanics and electricians).[30]

For training the teachers to then train students, we very roughly estimate another EUR 5 bn: considering training on the job, often, only few trainees have the same trainer, when in school, a teacher may teach 20 or more students. As a crude average, we consider 10 students per teacher, meaning that about 1.4 mn teachers should obtain qualifications, averaging to EUR 35.000 per teacher to cover training costs and compensation for salaries. With an average annual gross starting statutory salary of EUR 27,791 for teachers of upper secondary general programmes (European Commission, 2018b), and assuming training costs at this level to be a bit above those of students (e.g., around EUR 10,000 rather than 7,000), training of about 9 months per teacher is feasible.

The green stimulus will require rapid advanced education, although to a lesser extent, in other sectors, too. Without going into detail, we consider another EUR 5 bn here.

[27] Eurostat, *Annual expenditure on educational institutions per pupil/student*, `http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_fini04&lang=en`, accessed 13 December 2019. For upper secondary, non tertiary vocational education, the spectrum is even wider and no value for the EU27 is available.

[28] Eurostat, *Educational expenditure statistics*, `https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1154.pdf`, accessed 22 January 2020

[29] Eurostat, *National accounts employment data by industry*, `https://tinyurl.com/yzrdodgu`, accessed 18 November 2019

[30] Gehaltsvergleich.com, *Ausbildungsgehälter für die wichtigsten Berufe*, `https://www.gehaltsvergleich.com/ausbildung-ausbildungsberufe`, accessed 13 February 2020

5.4 R&D for decarbonisation, in particular IT-related

The energy transition requires massive investments in risky innovations, without assuming guaranteed success. They must be embedded in a broad social dialogue about technologies, lifestyles and future values. Special attention has to be paid to the IT-component of the relevant technologies.

In 2021, the EU's next framework programme "Horizon Europe" will start. The Commission's proposal is a EUR 100 bn research and innovation programme[31]. With a runtime of 8 years, average annual funding for research is in the order of EUR 12 bn. The expenditure profile sketched in this paper suggests to complement this programme with an additional annual EUR 7.5 bn for funding research and development to address tasks like the following:

- Large scale use of renewable energy to produce synthetic fuels from carbon captured at point sources and out of the atmosphere. This calls for digital technologies to optimally address the variability of renewables.
- In particular, a concerted European strategy for the generation and use of green hydrogen[32] (see also Section 5.2), as well as for innovation in battery technology.
- Variants of wind energy like harnessing high-altitude wind. Software for tackling turbulence is a key requirement here.
- Further technological options offering similarly uncertain but interesting opportunities.
- Digital technologies that support understanding of the dynamics of social systems, in particular in view of transformations, and that support the dialogue which should go with the research to enable participation of citizens in envisioning and shaping the transformation towards a carbon neutral economy.
- Technology that ensures maintaining the European take on data security and privacy issues in all fields where user data needs to be collected at large scales (e.g., mobility, smart homes).

With respect to other major economies, R&D intensity in the EU in 2017 (2.06%) was lower than in South Korea (4.55%), Japan (3.20%) and the United States (2.78%), while it was at about the same level as in China (2.13%).[33] The suggested additional investment being 0.05% of EU GDP, compared with the leading investors in research, room for improvement remains.

5.5 Subcontracting management tasks for implementing the European Green Deal

The present workforce of public administration will need reinforcement to implement the green stimulus. This holds for units at all levels of the administrative hierarchy. To take advantage of and strengthen the private sector, such reinforcement should happen mainly through subcontracting and similar instruments. This would also provide the opportunity to involve local actors directly not only in the implementation of measures, such as local firms renovating buildings, but also in the organisational implementation, e.g. prioritising the different measures as best fit for each local context.

[31] European Comission, *Horizon Europe - the next research and innovation framework programme*, https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en, accessed January 30 2020

[32] National strategies are being discussed, e.g. in Germany and France https://www.bmbf.de/de/nationale-wasserstoffstrategie-9916.html, https://www.handelsblatt.com/politik/deutschland/wirtschaftsminister-im-interview-peter-altmaier-ich-will-dass-das-wasserstoff-thema-fliegt/25288368.html,
https://www.hzwei.info/blog/2018/11/15/frankreich-investiert-in-wasserstoff-technik/

[33] Eurostat, *R & D expenditure*, https://ec.europa.eu/eurostat/statistics-explained/index.php/R_%26_D_expenditure, accessed 15 February 2020

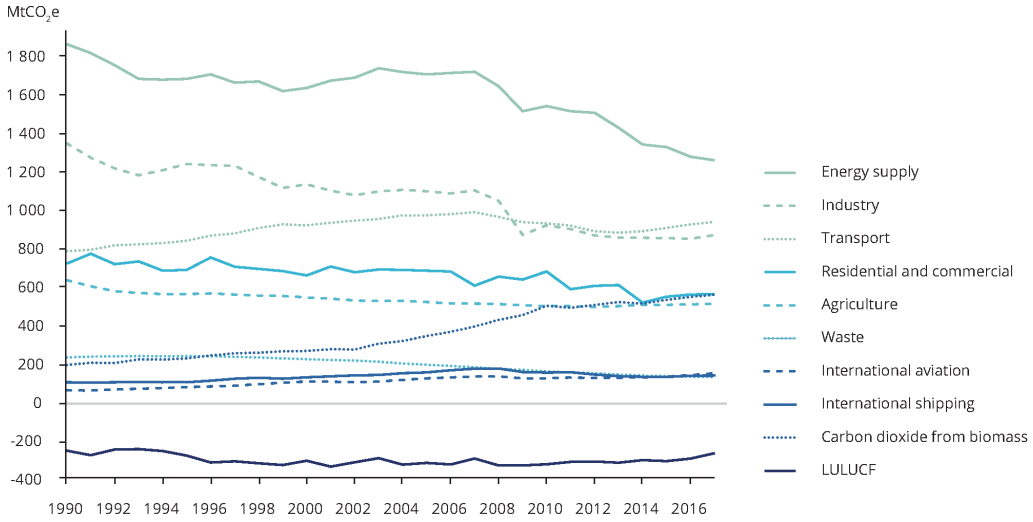

Fig. 6: GHG Emissions by Sector according to European Energy Agency

As a very crude estimate, we consider EUR 100 for an average European working hour of a subcontractor. With 8 hours a day and 250 days a year, this leads to EUR 200,000 for a person year. With an investment of EUR 7.5 bn, this corresponds to 37,500 person years. The use of these resources should include explicit training in the specificities of mega-project management (Flyvbjerg, 2014).

6 A new development path for Europe

This section presents expected effects of the strategy outlined above by drawing together rough estimates based on literature and basic calculations to provide a first sketch of its feasibility. More sophisticated estimates would require further research in terms of integrated modelling of systemic effects. This includes direct effects, such as how much CO_2 is avoided by renovating how many buildings, as well as indirect effects, such as a "green investment climate" and social dynamics stimulating owners to actually renovate their buildings. In any case, attempts at estimating how many emissions can be saved by various sectoral measures in isolation and then adding them up, will be misleading in the longer run. A crucial challenge for the European Green Deal is to develop the current European innovation system to the point where it can develop large-scale breakthrough innovations, and this will happen – if at all – through interactions between a wide array of sectoral dynamics.

6.1 Emissions

As described above, the carbon dioxide emission in the European Union have been decreasing overall, but at a rate much too slow for reaching the Green Deal goals, namely about 0.9% per year. Thus far, the overwhelming majority of emission reductions was obtained in the field of electricity generation, while emissions in the transport sector are above 1990 levels, see Figure 6. For the very short run, i.e. starting in 2021, we roughly estimate direct emission reduction effects of the building renovation and infrastructure investments outlined. An indirect effect on emissions of the training, R&D, and subcontracting investment would add to this.

6.1.1 Energetic renovation of the building stock

Buildings are accountable for 36% of the CO2 emissions in the European Union, around 1.4 bn tons.[34] As pointed out in Section 5.1 there exists a huge saving potential due to the disadvantageous age structure and the resulting lack in energy efficiency of the building stock. At the same time, data about the building stock could be much better[35], and this paper is not the place to go into much detail. Therefore, as a very crude estimate, consider that the renovation of "an average inefficient building"[36] into an efficient building reduces its emissions by 73%; for the most energy inefficient group of buildings, the reduction would be in the order of 76%. Renovation of 0.7 bn square meters per year corresponds to 3.5% of the building stock per year, on average producing 1.26% of EU emissions. Starting with the most inefficient type of buildings, 0.7 bn square meters renovated to efficient standards correspond to almost 1% decrease in overall EU emissions. For later years, calculations may have to be adapted depending on whether and how an innovation system in the construction sector succeeds in bringing down renovation costs and making the result more attractive to house owners as well as tenants.

6.1.2 Adaptive green infrastructure

Passenger cars are responsible for around 12% of total EU emissions of carbon dioxide (CO_2); lorries, buses and coaches contribute another 6%.[37]

Thus, to obtain an annual emission reduction in the order of 1% of total EU emissions, 1/18th, or 5.5%, of the current emissions from road traffic should be avoided.

From 2021 on, the EU fleet-wide average emission target for new cars will be 95 g CO_2/km; compared to the previous target of 130 g CO_2/km this is a decrease to about 73% of the previous level. As it applies to car sales, it will take some time to have an effect on the car stock. However, with an average lifetime of European cars of about 8 years,[38] about 37.5 mn cars are replaced each year. As the emissions of new cars underlie the stricter rules, and as the oldest cars from the fleet are more likely to be replaced, we estimate the average emissions of new cars to be half of the emissions from the cars they are replacing. The effect in terms of the total car fleet would thus be a reduction to about 94%, or, in terms of total EU emissions, about 0.75%.

With the infrastructure investments for electric vehicles as well as for walking and biking, seeds for a larger behavioural shift might be sown, but this will certainly take more time. Modal split (i.e., which part of travel is carried out with which transport means) of inland passenger transport in 2016 for the EU28 was almost 83% passenger cars, 9% motor coaches, and under 8% rail[39]. Such an average differs largely from the situation in many urban centers, which in turn show large differences with each other. E.g., with a use of cars from under 10% in London to 85% in Nicosia; with a use of bikes from 44% in Houten to 1% for a longer list of cities including Barcelona, Lisbon and Stockholm; 65% of walking in Bilbao, and 64%, respectively 63% of public transport in Ostrava, respectively

[34] Eurostat, *Energy Peformance of Buildings Factsheet*, `https://ec.europa.eu/energy/sites/ener/files/documents/buildings_performance_factsheet.pdf`, accessed 7 February 2020

[35] BPIE, *Building Performance Factsheet*, `http://bpie.eu/wp-content/uploads/2017/12/State-of-the-building-stock-briefing_Dic6.pdf`, accessed 13 February 2020

[36] BPIE, *Building Performance Factsheet*, `http://bpie.eu/wp-content/uploads/2017/12/State-of-the-building-stock-briefing_Dic6.pdf`, accessed 13 February 2020

[37] European Comission, *Reducing CO2 emissions from passenger cars*, `https://ec.europa.eu/clima/policies/transport/vehicles/cars_en`, accessed 23 January 2020

[38] European Enviroment Agency, *Average age of the vehicle fleet*, `https://www.eea.europa.eu/data-and-maps/indicators/average-age-of-the-vehicle-fleet/average-age-of-the-vehicle-8`, accessed 17 February 2020

[39] Eurostat, *Passenger transport statistics* , `https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_transport_statistics#Modal_split_of_inland_passengers`, accessed 17 February 2020

Klaipeda.[40] A successful European innovation system (in the technological sense) provides the opportunity of supporting also a "behavioural innovation system", e.g. for mobility in European cities.

As European railways are up to 9 times less CO_2 intensive than road for freight (see Finger et al (2019)), each percent of freight shifted from road to rail can further contribute, also in a shorter term perspective, to reducing the 18% of overall emissions from road transport. Between this point and behavioural changes, reductions in this field can be expected to increase over the coming years.

Further infrastructure investments proposed above can also provide emissions reductions, however, the effects are hard to quantify, especially for the short term. Some estimates in the literature seem "too good to be true"[41] – monitoring will be essential in the further development of the EGD.

6.1.3 Business as usual and the energy and industry sectors

As the investments proposed here are additional to existing measures, we further count on the average annual reductions of almost 1% continuing, at least for the short term. As mentioned, the bulk of emission reductions has taken place in the energy sector, and, up to about 2009, also in the industry. As carbon intensities in electricty generation differ widely between countries – e.g., Estonia (821 g CO2/kWh in 2016), Poland (773 g CO2/kWh), Malta (680 g CO2/kWh) and Cyprus (678 g CO2/kWh) on the upper end, and Sweden (13 g CO2/kWh in 2016), Lithuania (18 g CO2/kWh) and France (58 g CO2/kWh) on the lower one[42] – we estimate that in the short run, annual emissions reductions combined from industry and energy supply can be brought to 1%. In the longer run, breakthrough innovations, like those related to green hydrogen, will be crucial.

6.1.4 "Summing up"

Investments into education, research and administration, while necessary to make the EGD work, cannot be expected to have direct short term effects in terms of emission reductions. In the longer term, they will be crucial for supporting the European innovation system envisaged. As mentioned, summing up isolated effects from several sectors is misleading in the longer term perspective. However, as a rough feasibility check, we consider emission reductions in the order of 4% of the current values possible even in the very short term. Similar, or even increasing levels of absolute reductions can then deliver the average 5.5% needed to reach the EGD's target for 2030.

For the following two decades, where lower absolute values correspond to increasing percentages, but the low hanging fruit will already have been harvested, the evolution of a European innovation system will be key.

[40] EPOMM, *TEMS - The EPOMM Modal Split Tool*, `http://epomm.eu/tems/index.phtml`, accessed 17 February 2020

[41] E.g., according to BT (2019), ICT has the potential to reduce EU carbon emissions by over 1.5 Gt CO2e in 2030, corresponding to about 35%, so around 3.5 % per year.

[42] European Enviroment Agency, *Overview of electricity production and use in Europe.* `https://www.eea.europa.eu/data-and-maps/indicators/overview-of-the-electricity-production-2/assessment-4`, accessed 18 February 2020

6.2 Growth

The real GDP growth rates in the past 10 years have been between -0.4% (2012) and 2.6% (2016), varying around 2% except for the recessive year 2012.[43] The forecast for the EU in 2020 however is only around 1.5%.[44]

In the previous sections we have shown how an increase of publically triggered spending of EUR 150 billion in 2020 could be distributed amongst climate relevant activities to achieve a fast decarbonisation for the European Union. These additional investments will also lead to a change of GDP growth via a fiscal multiplier. Under the given economic circumstances, a reasonable fiscal multiplier for the EU is around 1.5% (Boitani and Perdichizzi, 2018). The proposed increase of investments of 1 % annual GDP will thus lead to an additional growth of 1.5% of GDP, or higher, taking into account that additional private financing has been assumed e.g. for renovating buildings. Together with a projected growth rate of 1.5% for 2021, which we consider constant from 2020 for lack of other information, the annual growth rate will thus sum up to 3%. This does not consider more indirect effects, such as the role of technical change, nor the fact that training accelerates the rate of productivity growth (Sala and Silva, 2011), so that growth effects can be expected to be larger in the longer run.

With a European Green Deal along lines similar to those discussed here, the goal of achieving average growth rates clearly above 2% is certainly realistic.

6.3 Unemployment

Unemployment goals stated in Section 2.2 are a longer-term issue. However, as was also stated, tangible improvements should be noticeable soon, in order to create support for the EGD. With a multiplier of 1.5, the EUR 150 billion envisaged for 2021 translate into EUR 225 billion. The country worst hit by unemployment in general and specifically for youth is Greece. Average annual salaries in Greece are in the order of EUR 10000. The population of Greece is about 10 million people, i.e. about 2% of the EU population. If 3% of the 225 billion are deliberately directed towards investments in Greece, the resulting nearly 7 billion would suffice to create (taking into account that not all money will go into wages) about half a million jobs. By focusing hiring on young people, the general unemployment rate, respectively the youth unemployment rate could easily reach the target of falling to less than 7%, respectively less than 15%. Clearly, the resources allocated to vocational education would then have to be directed to advanced education, as a large fraction of young unemployed in Greece already have a formal education.

Greece is the most extreme case. If the stated goal can be reached there, by the same token it can be reached in the countries whose unemployment rates lie above the declared targets. This is not to say that it would be easy, quite the opposite: It is one of the big challenges for the European Green Deal. One crucial condition would be to link the efforts to nudge the European innovation system towards breakthrough capacity to economic activities in countries that cannot become strongholds of this capacity. While this would be far from trivial, it is by no means impossible.

6.4 Inflation

In the present situation, the main challenge for the ECB is to bring the average inflation rate closer to 2%. It is obvious that an investment push of the kind considered here, while

[43] Eurostat, *Real GDP growth rate - volume*, `https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00115`, 10 February 2020

[44] European Commission, *Commission publishes Spring 2019 Economic Forecast*, `https://ec.europa.eu/commission/news/commission-publishes-spring-2019-economic-forecast-2019-may-07_en`, accessed 20 December 2020

small in comparison of the original New Deal or the Obama-Geithner stimulus, would make it easier to reach that goal. If a catch-up of wages with regard to productivity is supported, as desirable, it would get even easier. It is important to understand that an increase from present levels of price increase, by a few percentage points, facilitates an innovative dynamics of the overall economy, keeps the danger of deflation at bay, and creates leeway for policy responses in future crises.

If the European Green Deal really takes off – as opposed to just public relations exercises with little practical impact – the converse question arises: can a rise of inflation above the target set by the ECB be avoided? This is where the quality of the European innovation system and the development of new forms of vocational education become crucial. Improvements in these two areas, as foreseen in our structuring of the EGD, create the capacity and flexibility of production needed to avoid the bottlenecks that might lead to problematically high rates of inflation.

7 Conclusion and Outlook

The European Green Deal has rightly been described as a challenge but also as an opportunity. In fact, if successfully implemented, it presents an opportunity not only in the environmental and climate dimension, but also in the social and economic realm. With Brexit as the most obvious example, but also with rising support for anti-European parties in many countries, it has become obvious that the European Union, once a promise of peace and prosperity, is facing difficulty in uniting the European people in the best case, and may be facing breakup in the worst case. Since Mario Draghi, in 2012, pointed to 'large parts of the euro area in what we call a "bad equilibrium"' (Draghi, 2012), well-being for most people has increased too little and unemployment, especially for the young, in some countries is still way too high to now negate this statement.

This paper aimed to show that the large scale investments necessary for a Green Deal have the potential of heaving the European economy onto a new development path. Unused resources and capacities are currently available, both in terms of finance for investments and in terms of people looking for jobs or operating way below their capacities. The EGD can provide the ambitious mission around which a virtuous circle of investment, innovation, and confidence could cristallize to accomplish the shift to a new path.

On a positive note, once reached, such a development path can be maintained without maintaining the large levels of public investment needed to initiate the shift. With directed technical change, there are no incentives to shift back to "brown" once "green" is available (Acemoğlu et al, 2012). With change in social norms, if cities become more liveable, to pick just one example, the probability of inhabitants actively striving for a return to more pollution, noise, etc, seems negligible (Gehl and Rogers, 2013).

Of course, setting the virtuous circle into motion is a huge task. The structure of a Green Deal sketched in this work should be seen as an impulse for dialogue and further research to support this task and those who set out to accomplish it. Rather than planning out a detailed strategy for the next decade, we aimed to provide a consistent example of elements that need to be thought about, to sketch orders of magnitude that can be relevant and feasible, and to point to questions that will need answering – other questions will certainly arise.

An essential point in shaping the Green Deal is the openness of the future. As Snyder (2019) points out, democracy needs alternative possible futures for engaging citizens. The Green Deal "means change" (von der Leyen, 2019), and the direction of change away from emissions is clear. How to achieve this, and what other kinds of change need to or should accompany this, is up to how the EGD will be shaped. Research should provide evidence on what is feasible as best it can, and technology development is needed to provide options, but decisions on what is desirable and who should contribute how to implementing change, are up to society's processes of negotiation and deliberation – policy makers at all

levels are part of society, albeit with a special role. A co-evolutionary approach between policy, technology, and society seems to offer the best chance of successfully designing and implementing the Deal. It can be supported by the application of formats such as the "Decision Theatre" methodology[45], which supports discussion with interactive visualizations of empirical information and future scenarios derived from model simulations.

Such evidence-based discussion will be needed in many a committee, from local stakeholder groups to national parliaments and international groups, such as the recently formed dedicated working group of the Franco-German Parliamentary Assembly.[46] Possibly the most important inter-institutional working group that will be needed would be one bringing together European Commission, ECB, and IMF, to support their three leaders in implementing the stated plans. A first point for discussion between these three entities would be how to enable very modest but helpful budget deficit increase (in the order of e.g., 0.2%, see Section 4) so as to kick-start the process of stimulating additional, not merely shifted, investments. Discussions in the Eurogroup would then be supported by suggestions from such a working group.

On that basis, the EGD may succeed in forming a European innovation system capable of large-scale breakthrough innovations. There are many opportunities for breakthroughs, e.g. around the issue of energy-efficient buildings, of green hydrogen, or around the issue of sustainable mobility for liveable cities. Along these lines, the European Green Deal may live up to the stated goal of making Europe a global leader.

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