SOME ARGUMENTS FOR INCREASING THE EU'S 2030 CLIMATE AMBITION

Objective: Making the case that it would be advisable to significantly increase the EU's pledged 2030 emissions reductions, in order to ensure a politically resilient decarbonisation pathway domestically and internationally that is consistent with the Paris Agreement.

KEY MESSAGES

Under the Paris Agreement, governments agreed to come together every five years to set more ambitious emissions-reduction targets, as required by science. Current commitments are not sufficient to keep global warming below 2°C. A tightening of these commitments in the EU by 2020 would, in fact, reflect the current domestic legal framework, which should already lead to deeper decarbonisation than the current target of a 40% emissions cut by 2030 compared to 1990.

More ambition from the EU would help to avoid unnecessary investment, prevent too great a reliance on negative emissions, and keep the 1.5°C ambition within reach. Deferred decarbonisation will lead to a larger power system and cause a short-lived gas-demand bulge, which would imply a higher total cost. At the same time, faster capacity expansion can reduce dramatically the future cost of low-carbon technologies, and switching earlier to faster learning technologies implies economic benefits over time. As the low-carbon technology race is still being run, and certain European regions have the potential to specialise in certain low-carbon technologies, early action can help translate this potential into an actual competitive edge.

Delaying further action in the EU will result in very unbalanced efforts before and after 2030. The steep changes left for the post-2030 period might cause social pain and political instability, and pose an even greater risk to financial stability. To avoid stranded assets and economic disruption in the EU, it is urgent to increase low-carbon investment and phase-out fossil fuel investment.

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This brief compiles research from COP21 RIPPLES Deliverables D2.1, D2.3, D3.2, D3.3 and D4.2 involving the following institutions: Bruegel, Climate Analytics, CNRS, IDDRI, UEA, UOXF, WI. It includes comments received from key stakeholders during the project's First Policy Dialogue (https://www.cop21ripples.eu/events/first-policy-dialogue-in-brussels/) when a draft was presented for discussion. Chloé De Meulenaer (Bruegel) coordinated this brief.

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Introduction

In 2015, the EU committed to reduce its greenhouse-gas emissions by 2030 by 40% compared to 1990.[1] But various stakeholders—including the European Parliament[2]—have called for significantly larger cuts by 2030 to respond to the current international ambition gap. In late 2018, the European Commission published its *long-term vision* for a climate-neutral economy and more recently the European Council failed to agree on a common 2050 target.

In 2020 the EU is required under the Paris Agreement to communicate an updated commitment (known as an NDC) and a long-term strategy to the global climate secretariat.[3] According to the Paris Agreement, the updated NDC should represent a progression beyond the previous commitment, reflect the greatest possible ambition and contribute to achieving the long-term temperature targets. In light of this obligation, it is sensible to ask whether the current domestic 2030 and 2050 targets meet these conditions.

And the newly elected Commission president has taken up this question. In her Political Guidelines Commission President von der Leyen[4] made "more ambitious targets for 2030" a headline, voiced her desire "to reduce emissions by at least 50% by 2030" and promised to put forward "a comprehensive plan to increase the European Union's target for 2030 towards 55% in a responsible way".

In this Policy Brief we will reflect on the case for increasing the 2030 target based on the research results of the COP21 RIPPLES project.

The current legal framework is more ambitious than the 2030 targets

In its *long-term vision* for a climate-neutral economy, the European Commission[5] showed that the 40% cut by 2030 is less ambitious than the emission reductions (-48% by 2030 p.198) that would result from implementing the already agreed renewables and energy efficiency targets.

The current targets are incompatible with the Paris Agreement goals

Furthermore, the current global set of nationally determined contributions (NDCs)—including the EU's—put the world on a path to a temperature increase of around 3°C, thus failing to achieve the goal of keeping the temperature increase well below 2°C, let alone below the 1.5°C-threshold suggested by the Paris Agreement to mitigate climate-related risks and costs.

1 Latvian Presidency of the Council of the European Union (2015). Intended Nationally Determined Contribution of the EU and its Member States, Riga, 6 March 2015, accessible at *https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/European%20Union%20First/LV-03-06-EU%20INDC.pdf.*

2 In a resolution in March 2019 the European Parliament called for a 55% reduction by 2030.

3 Acc. to Article 4 of the Paris agreement.

4 *www.europarl.europa.eu/resources/library/media/20190716RES57231/20190716RES57231.pdf*

5 European Commission (2018). A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy, COM(2018) 773.

The EU long-term vision ignores benefits of earlier action

In its vision for a climate-neutral economy the European Commission analyses different pathways for the EU to contribute to the 2°C and 1.5°C targets. A key result is that the EU would have to massively step up its decarbonisation efforts. While in the business-as-usual scenario, emissions are expected to fall by a third between 2030 and 2050, a pathway in line with the 2°C target would require a reduction of about 75% during this period.

The very steep decarbonisation needed after 2030 to keep to a 2°C compatible pathway is partly because the Commission started from a pre-defined level of action around 2030, not much lower than implied by its NDC. The 2030 level was not derived from an "optimal" long-term trajectory from 2020 emissions levels towards zero emissions in 2050. As a result, the mandated 2030 emissions levels are much too high for an optimal 1.5°C trajectory, potentially setting up the system for failure to achieve the required zero emissions level by 2050. Even worse, the 2050 levels would need to be below zero to compensate for the higher emissions early on, and to keep within a total fixed emissions budget consistent with the Paris Agreement.

In the following chapters we assess the technical, economic and political implications of starting with a pre-defined level of action around 2030.

Table 1. EU's 2030 emission target is higher than emissions implied by current policies and targets

Annual emissions in 2030 (change compared to 1990)	NDC
2.9 Gt (-48%)	3.3 Gt (-40%)

Note: total GHG incl. LULUCF
Source: In-depth analysis accompanying the EU long-term Vision (p.198) https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf

Table 2: Reduction in emissions between 2030 and 2050 in different scenarios

BAU	2°C	1.5°C
31%	71-78%	100%

Note: total GHG incl. LULUCF; 2030 BAU emissions of 2850 Gt.
Source: In-depth analysis accompanying the EU long-term vision (p.198) https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf

The socio-economic transition case for speeding up[6]

We compare two of national decarbonisation pathways for five EU countries (France, Germany, Italy, Poland and the United Kingdom) that represent two-thirds of current EU emissions. Both families of national scenarios were developed by national research teams to be consistent with the Paris Agreement global temperature targets.

The delayed-action family refers to national emissions pathways considered as consistent with the overall EU NDC objective for 2030, with increased ambition after 2030 in order to be in line with a Paris-compatible carbon budget by 2050. Aggregated energy-related CO_2 emissions for this group of five countries are 38% lower in 2030 than in 1990.

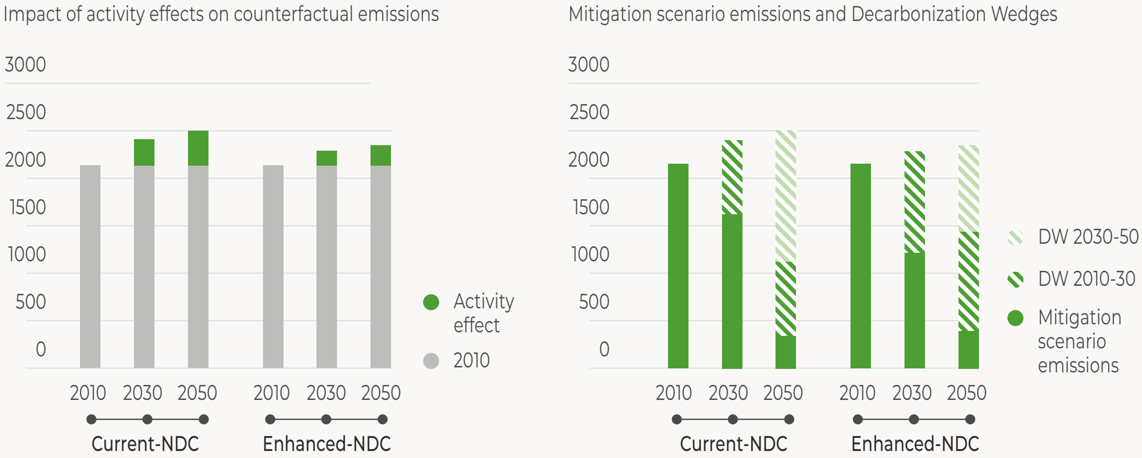
In the earlier-action scenario, emissions are already reduced more strongly before 2030 (-54%). Both scenarios lead to similar energy-related CO_2 emission budgets from 2011-50 but with different emission-reduction profiles over time.

Delayed action makes necessary a strong acceleration of efforts after 2030

Taking more ambitious steps earlier allows for a stable level of effort to be maintained until 2050, while delayed action postpones most of the effort to the 2030-50 period. Thus, in the earlier-action scenario, we calculate a relatively comparable reduction effort of 49% of the 2010 emissions level during 2010-30 and 42% during 2030-50. Delayed action requires the reduction effort in the second period to be almost twice as high (a 63% emissions reduction compared to the 2010 emissions level) than in the first period (36%). This is illustrated in **Figure 1**.

6 The content of this section has been provided by Sandrine Mathy and Silvana Mima (CNRS) and is based on Mathy et al. (2018a) and Current-NDCs and Enhanced-NDC scenarios produced with POLES model (developed by GAEL/CNRS). The methodology used refers to Mathy et al. (2018b).

Figure 1. Impact of activity effects (exogenous change in economic activity) and decarbonisation efforts over time for delayed and earlier-action scenarios in the EU-5



Note: 'Current-NDC' refers to the delayed-action scenario, whereas 'Enhanced-NDC' represents the earlier-action scenario. The impact of activity effects and decarbonisation efforts is calculated according to the decarbonisation wedges (DW, i.e. policy-driven emission reductions) methodology proposed by Mathy et al (2018).

Source: POLES, COP21 RIPPLES

Late decarbonisation benefits electrification, but at high cost

Delayed decarbonisation is made possible by a massive decarbonisation of electricity in parallel with the electrification of end-uses of final energy consumption. In 2050, in the five countries, under the delayed-action scenario, more than half of all energy would be provided through electricity (51%), while in the earlier-action scenario, only 38% of all energy is provided through electricity. The delayed-action scenario for the five countries hence requires investment in the capacity to produce in 2050 about 1,300 TWh more decarbonised electricity (renewable, nuclear or carbon capture and storage (CCS)) than in 2030, in addition to the renewal of end-of-life carbon-free generation capacities in this period. This figure is twice as high as the additional production of carbon-free electricity in the earlier-action scenario.

This sharp increase raises the question of socio- and techno-economic feasibility. From an economic point of view, the slow deployment of low-carbon technologies during the first period in the delayed-action scenario will necessarily slow down learning-by-doing in renewable technologies and will increase the cost of renewables in the second period compared to the earlier-action scenario. No doubt the global cost of the delayed-action scenario would be much higher than the earlier-action scenario.

Late decarbonisation requires CCS, causes a short-live gas-demand bulge and might cause social pain

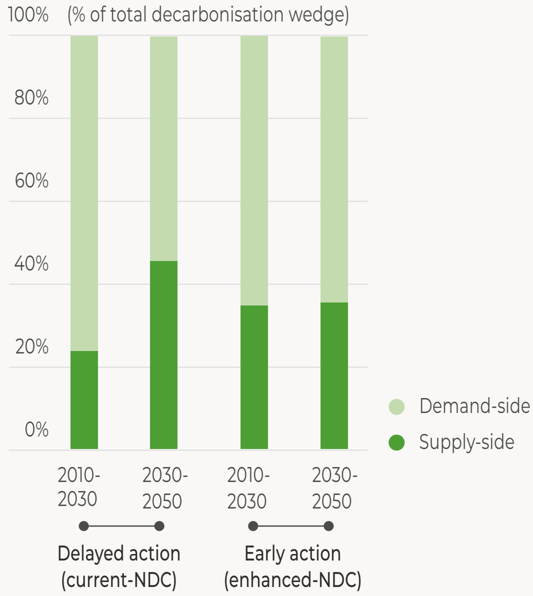
Another consequence of the delayed-action scenario is the relatively high emission intensity of electricity production up to 2030. Generation of electricity from fossil fuels, in particular coal, is higher in the delayed-action scenario than in the earlier-action scenario, where electricity is already largely carbon-free by that date. This has several consequences. First, to avoid excessive stranded costs arising from then-existing coal-fired power plants, the use of carbon capture and storage plays a stronger role just after 2030 in the delayed-action scenario, despite the high uncertainty about the availability of this technology at this time. On the other hand, because of the delay in learning-by-doing in renewables, gas might gain the upper hand over coal (too dirty) and renewables (still too expensive) for a few years, creating risks of lock-ins or stranded assets. Finally, the rapid closure of many coal-fired power plants in the countries concerned (mainly Germany and Poland) will inevitably lead to problems of unemployment and political acceptability, which will have to be managed through adapted accompanying policies and measures. These consequences are much less intense in the earlier-action scenario, which results in a continuous but significant reduction of coal in the energy mix and therefore does not use CCS or the substitution of coal for gas.

Easy 2030 targets can be reached by reducing demand – but then it gets difficult for 2050

In the delayed-action scenario, more than 75% of the decarbonisation effort by 2030 can be achieved through energy-efficiency measures. But after most of the easiest measures have been taken by 2030, supply-side measures have to become much more important. By way of contrast, in the earlier-action scenario, supply and demand-side measures can be symmetrically distributed between both periods (see **Figure 3**).

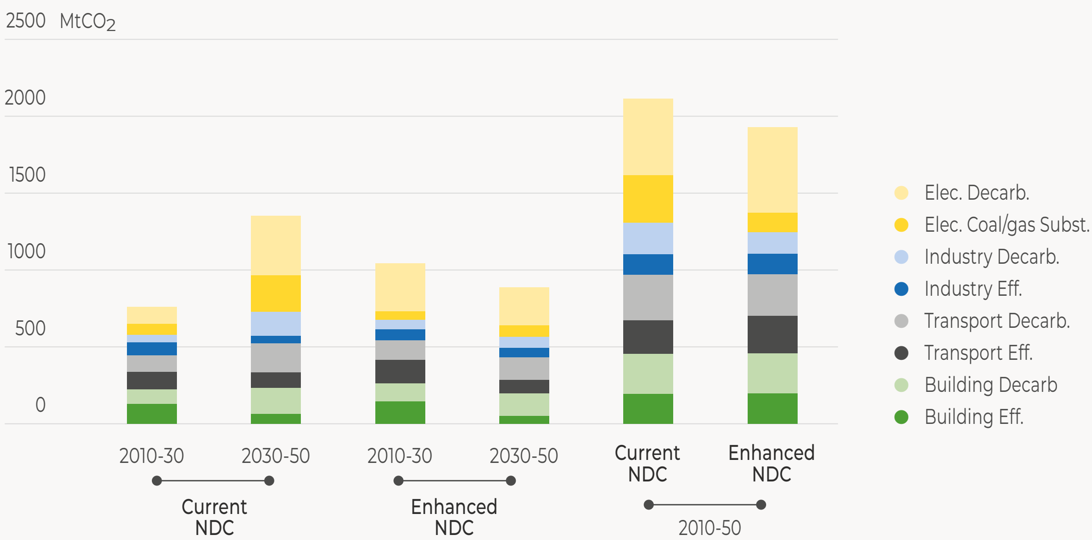
A strategy based on additional demand-side mitigation actions, the penetration of renewables and an early but gradual decrease in coal capacity in the power sector before 2030, seems to be the most appropriate strategy to raise the EU's NDC ambition and remain on track to meet the Paris Agreement goals.

Figure 3. Contribution of demand-side and supply-side emissions reduction efforts



Source: Bruegel, COP21 RIPPLES

Figure 2. Sectoral decarbonisation efforts in the EU-5 region



Note: See note to Figure 1.

Source: POLES, COP21 RIPPLES

The high-ambition case for speeding up[7]

To keep 1.5°C within reach, the EU's 2030 emissions need to be significantly below the current target

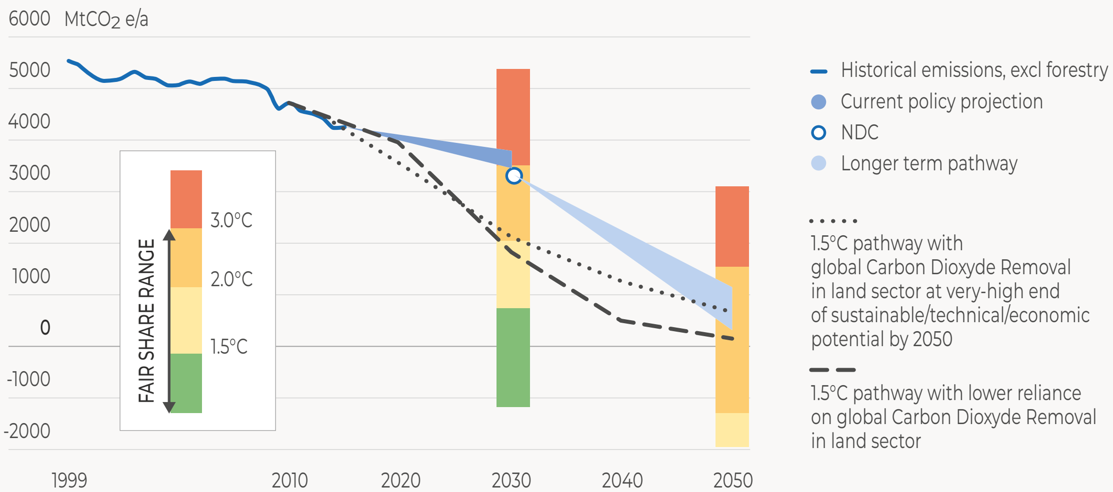
At a global level, achieving the long-term temperature goal of the Paris Agreement requires NDCs and mitigation efforts to be ramped up rapidly, towards much deeper global emissions reductions. The IPCC 1.5°C Special Report finds that to keep the global temperature increase below 1.5°C, global GHG emissions should be in the range of 25-30 $MtCO_2eq$ by 2030 (Allen et al 2018). That is about half the level implied by NDCs (52-58 $GtCO_2eq$). Stronger emissions reductions by 2030 lead to a higher chance of limiting warming to below 1.5°C, with no or limited overshoot. However, the 1.5°C Special Report is clear that any delays in achieving emissions reductions by 2030 will lead to higher overall mitigation costs and particularly steep cost increases in the 2030-2050 period, and to a high dependency on so-called negative emissions. Both factors imply a high risk of failing to achieve the faster emissions reductions that would be required later on, to compensate for insufficient action in the coming decade. To avoid such risks, global emissions should decline sharply in the coming decade, with the goal of achieving net-zero global CO_2 emissions by mid-century and net-zero global GHG emissions by 2070.

For the EU, we can illustrate these issues by comparing 2030 emissions levels implied by the EU NDC with emissions levels that would be consistent with the Paris Agreement. We compare (1) policy projections based on existing NDC levels (blue and red fan in **Figure 4**), (2) equity considerations[8] (colour-ranges in **Figure 4** – with green signifying that the EU contributes its 'fair share' to global decarbonisation)

7 The content of this section has been provided by Michiel Schaeffer and Fabio Sferra (Climate Analytics).

8 Equity considerations generally result in emissions reductions at a national or regional level that are different from those derived from energy-economic (least-cost) model results. Whereas energy-economic models achieve emissions reductions at any place and time that lead to lowest cost globally and over the whole period of modeling (mostly to the end of the twenty-first century), equity considerations aim to quantify what is 'fair' in terms of the emissions reduction 'burden' of countries compared to others. Equity approaches, and therefore the numerical outcomes, differ widely and include responsibility (e.g. how much of current global warming can be attributed to past emissions of a given country), capability (e.g. how much could a country afford), equality (e.g. emissions per capita converge) and others. See e.g. Höhne et al. (2014).

Figure 4. GHG emissions in the EU28 (excluding land use, land use change and forestry)



*Note: Historical emissions time series, current-policy projections, NDC and current long-term target analysis, as well as "equity" ranges, from Climate Action Tracker (CAT 2018). Two least-cost 1.5°C trajectories are provided for comparison. Red dashed line: pathway that would be 1.5*C compatible assuming Carbon Dioxide Removal in the land sector at the very-high end of what SR1.5 estimated to be the maximum sustainable, technical and economic potential by 2050. Dashed red line: 1.5°C pathway with a lower reliance on global CDR in the land sector.*

Sources: COP21 RIPPLES analysis based on CAT (2018), PBL (2018), IEA (2017).

and (3) two least-cost Paris Agreement compatible pathways (dashed lines in **Figure 4**). The two different least-cost Paris Agreement compatible pathways reflect different assumptions on the role of carbon dioxide removal (CDR)[9]. The first of these would be compatible with 1.5°C, assuming CDR in the land sector at the very-high end of what the IPCC Special Report estimated to be the maximum sustainable, technical and economic potential by 2050 (dashed yellow line: IEA-B2DS scenario; IEA ETP 2017). The second example has a lower reliance on global CDR in the land sector (dashed black line: IMAGE model pathway downscaled to the EU28 by tools developed within the COP21 RIPPLES project; Sferra *et al.*, 2019—forthcoming).

The results show that against any of these equity-based or least-cost benchmarks, far deeper reductions by 2030 are needed than implied by the EU's current NDC. It is also clear that least-cost pathways towards the 1.5°C limit require deeper reductions than the EU's current mid-century target. Mid-century emissions should be zero, unless extreme global CDR is assumed.

Equity considerations would require the EU to invest in additional reductions beyond its borders

Least-cost pathways imply domestic emissions reductions. The overview of equity calculations shown in **Figure 4** shows that 'fair' emissions reductions for the EU are yet deeper, which implies that the EU needs to substantially contribute to the international cooperation effort to enable further emission reductions in other regions (notably in developing countries). This would need to come not in place of, but in addition to, investments aimed at achieving domestic reductions under the least-cost pathway – and we have seen that these reductions need to be much larger than implied by the current EU NDC. Hence, even with zero total GHG emissions in 2050, the pathways in the European Commission's long-term vision are not 1.5°C-consistent, because high 2020-2040 emissions lead to the EU's emissions budget being exceeded.

9 CDR is an ensemble of technologies for the large-scale removal of carbon dioxide from the atmosphere including biochar, bio-energy with carbon capture and storage, direct air capture when combined with storage, enhanced weathering and ocean fertilization.

The governance case for speeding up[10]

Maintaining the EU's climate leadership role

One of the key features of the Paris Agreement is that it provides a clear signal not only to signatories but to all kind of actors across governance levels. This signal works because the Paris Agreement has demonstrated the determination and dedication of governments to take bold action. One effect has been to embolden non-state and subnational actors: in the United States for example, under 'America's Pledge', a broad coalition of actors has sought to compensate for the policy reversal of the Trump Administration. Moreover, the Paris Agreement has shifted the expectations of investors, leading them to change their investment decisions.

Taking into account the recent IPCC Special Report on the 1.5°C target, and the outcomes of the Talanoa Dialogue that concluded at COP24 in Katowice, a failure to increase ambition before 2030 from the EU's side would almost certainly be a blow to the guidance and signal function of the Paris Agreement. The EU would undermine not only its own credibility but also that of the Paris Agreement as a whole. Leading by example was for a long time the precept of EU climate policy in the international realm. Not increasing current 2030 and 2050 targets could well set a dangerous precedent.

What is more, by not acting in accordance with the 1.5°C target, the EU would risk its role as a diplomatic leader and agenda-setter on environmental issues. More specifically, not increasing the ambition of the first NDC could reduce the EU's clout within the UNFCCC negotiations. At both the Paris and Katowice COPs, the EU drew on the 'High Ambition Coalition' to achieve an ambitious negotiation outcome. Not raising its ambition could trigger a sentiment of unreliability on the part of the other members of the Coalition, significantly reducing the EU's options for strategic alliances in future climate change negotiations.

10 The content of this section has been provided by Lukas Hermwille (Wuppertal Institute) and Tim Rayner (UEA).

Sectoral approaches could enable higher ambition

COP21 RIPPLES researchers assessing the 'Adequacy of COP21 Outcomes for Effective International Climate Governance and the EU's Role' (Rayner *et al.*, 2018) noted how, in accordance with Article 2.1 of the Paris Agreement, the global response to climate change has to be strengthened *"in the context of sustainable development and efforts to eradicate poverty"*. Fairness and social acceptability may therefore be regarded as integral to 'adequate' international governance, a recognition increasingly reflected in the concept of the 'just transition'. Climate policy that is perceived to be unjust risks provoking a backlash, as has arguably been witnessed in the recent rise of the *gilets jaunes*. At the same time though, the burgeoning 'Fridays for the Future' student movement condemns insufficiently ambitious climate policy as a case of inter-generational injustice. Where, then, does this leave EU attempts to increase its policy ambition?

To date, much decarbonisation has been achieved by policy instruments that operate in a largely invisible way. When their effects (for example in raising consumer prices) become apparent, they may lose legitimacy. To reduce this risk, policymakers (at EU, national and local levels) seeking to increase the rate of decarbonisation must do so more explicitly. Policies should be developed in a way that more effectively engages affected communities, and produces economic and societal transformations with clearly identifiable benefits. Doing this along sectoral lines, specifying pathways and seeking ways for a just transition in order to avoid hardship might be helpful in that regard, given that individual sectors possess unique dynamics and face specific transformation challenges.

The relevance of each of the different functions with which inter- and transnational governance can support decarbonisation varies significantly across sectors. The UNFCCC provides transparency and guidance at the aggregate level, but it lacks sufficient granularity to meaningfully inform sectoral transformations. When analysing the broader climate landscape, COP21 RIPPLES finds that across sectors, the gap is most serious in terms of setting rules to facilitate collective action. Guidance and signal can also be seen as lacking, particularly in the following sectors: financial, extractive industries, energy intensive industries, and buildings. The function of providing opportunities for knowledge dissemination and learning is closest to being adequately fulfilled. Yet, it is also the least contentious function and it hardly threatens incumbent interests (COP21 RIPPLES, 2018).

The innovation case for speeding up[11]

Faster capacity expansion can reduce dramatically the future cost of low-carbon technologies

Innovation is key to reducing the costs of technologies required for a clean energy system. Major cost reductions have already been achieved for solar, wind and battery technologies, and progress is now being made on electric vehicles (EVs), EV charging networks, residential battery energy storage, heat pumps, hydrogen electrolysers and more. Progress in such products is built on innovation in the underlying electronic, material and digital technologies, and in the business models and end-use service arrangements via which they diffuse throughout the economy. Many of these are not new technologies though, and companies are only now starting to take seriously the need to increase innovation and deployment in these areas. It is therefore likely that there is scope for faster progress if the incentives of industry, governments and the public can be aligned around the attractive prospect of much lower technology costs in future, and increasingly effective climate action.

The amount of progress a technology makes depends directly on the amount of effort expended on improving it (a mechanism known as Wright's law). The impact is different for different technologies. By observing how effort translated into progress in the past for a specific technology, forecasts for future progress can be made, depending on specified levels of effort. Cumulative production or cumulative capacity installations have proved to be reasonable approximations for the total effort expended throughout the entire technology supply chain, from basic science, R&D and innovation to deployment.

11 The content of this section has been provided by Rupert Way (University of Oxford).

Figure 5 (left plot) shows two such forecasts for photovoltaic (PV) system prices examined under COP21 RIPPLES. Historical data for global PV capacity installations and installed system prices for large-scale US systems are shown. In addition, two scenarios with different growth in capacity deployment are shown (extending from the top of the historical capacity curve). Finally, the system price forecasts associated with each of these scenarios are shown. The Low Ambition scenario[12] implies only a 10% annual capacity growth rate. This represents a massive slowdown in the growth rate of capacity, yet is approximately the level of ambition currently envisaged by the International Energy Agency (IEA). If global capacity follows this path then we expect the system price to be between 450 and 1,000$/kW (the red fan) in 2030—our median estimate is 660$/kW.

If, more in line with the historical growth rate, global capacity follows the green, High Ambition path (28% annual growth rate), then the median forecast system price in 2030 is 352$/kW, and the 50% confidence interval follows the green fan (200-600 $/kW). Thus, an extra halving of the price of PV systems by 2030 is at stake, and policy has the means to make this much more likely.

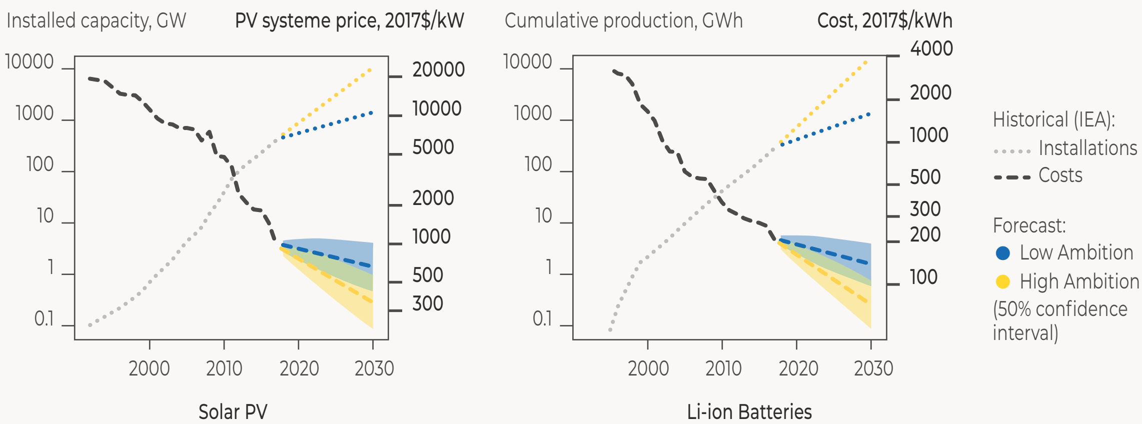
Figure 5 (right plot) shows the same analysis repeated for lithium-ion batteries. If global cumulative production of batteries follows the Low Ambition path, battery costs are likely to be between 100 and 200$/kWh in 2030 (the red fan), with a median forecast of 139$/kWh. But following a High Ambition path gives a median forecast cost of 72$/kWh, and a 50% confidence interval of 50-105$/kWh (the green fan). Again, an extra halving of costs by 2030 is at stake.

12 The Low and High Ambition scenarios correspond to the respective low- and high-growth scenarios underlying the analysis of COP21 RIPPLES D3.3.

Switching earlier to faster learning technologies implies economic benefits over time

COP21 RIPPLES research shows progress rates are technology-specific though, so each technology must be considered separately. As shown, speeding up is likely to bring large innovation benefits for both PV systems and batteries; but corresponding analyses reveal that similar results also hold for wind and hydrogen electrolyser technologies, both of which are essential for the clean energy transition. However, nuclear and fossil-fuel based technologies *do not* follow this pattern. Fossil-fuel technology prices have

Figure 5. Solar PV and battery cost forecasts as a function of cumulative experience in Low Ambition and High Ambition scenarios



Note: This analysis does not explicitly model innovation per se: it gives cost forecasts based on two capacity growth scenarios, in which the entire innovation chain is assumed to be responsible for the cost reductions shown. Policy is assumed to set the agenda for the level of capacity installed, with higher ambition leading to faster innovation, learning and technological progress.

remained approximately at the same level for the last century, while nuclear investment costs have on average increased[13]. There is no general historical downward trend in either of their costs or prices, implying that further effort on these technologies is unlikely to result in cost reductions in future. It would be far better to start building a clean energy system in earnest immediately. Strong, committed, early action following a high-ambition path is likely to lower the cost of promising green technologies significantly, resulting in a clean energy transition that is both fast and cheap.

The industrial policy case for speeding up[14]

The low-carbon technologies race is still open

Export specialisation patterns are found to be quite path dependent. This implies that countries rarely make large jumps in terms of the products they are particularly good or bad at exporting over time. However, compared to other exported products, the path dependency in low-carbon exports such as wind turbines, electric vehicles and batteries appears to be below average most of the time. For quickly emerging markets such as batteries and electric vehicles in particular, this is striking, while wind-turbines specialisation started to mature around 10 years ago. This indicates that certain countries might find it easier to develop new strengths in emerging low-carbon sectors, than in more mature sectors.

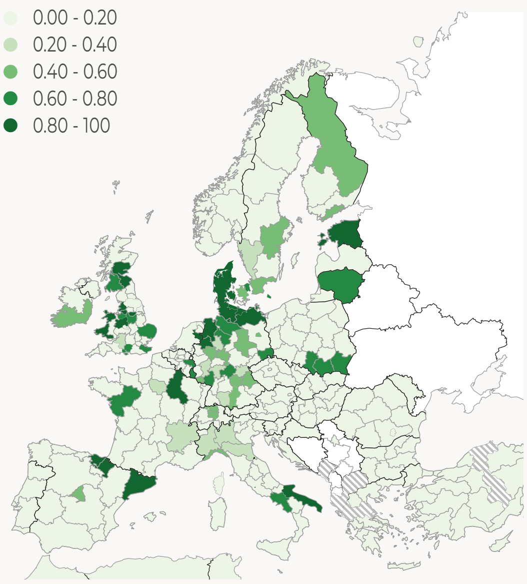
Specific European regions are already today specialised in certain low-carbon technologies

Already today a number of European regions are specialised in specific low-carbon technologies. This can be nicely illustrated by highlighting regions where the share of patents in a low-carbon technology exceeds the average share of patents in this low-carbon technology (see **Figure 6** for wind technology). For example, in the Basque country, the share of wind patents in all patents is 2.12%, while in the global average it is only 0.32%, on average between 2014 and 2016.[15]

Specific European regions have the potential to specialise in certain low-carbon technologies

Moreover, technological specialisations are clearly related. Regions that are now specialised in photovoltaic patenting were very often specialised in the past in electrical resistors. There can be a number of reasons for such proximities, but they are

Figure 6. Map of Revealed Technological Advantage in 2015 for NUTS2 European Regions in wind technologies



Source: COP21 RIPPLES based on Patstat

13 The causes behind this lack of progress are not well understood, but are probably diverse and technology specific. For fossil fuels, their depletable nature means that many technological advances simply go towards extracting ever harder to reach resources, resulting in a "running-to-stand-still" dynamic. For nuclear technologies, the large system size, small number of units produced, long construction times and complex safety considerations severely limit opportunities for learning throughout the entire technology innovation chain. In fact, in some parts of the extended learning system, such as financing, regulation and politics, extra experience has often led to tighter regulation, higher interest rates, and other factors likely to have contributed to the gradual increase in total costs observed.

14 The content of this section has been provided by Georg Zachmann (Bruegel) and is largely based on the work conducted under D3.3 of the project.

15 Hence the Basque country is seven times more specialised in wind patenting than the global average—resulting in a normalised revealed technology advantage of 0.875. See COP21 RIPPLES – D3.3 p.17.

strong enough to allow some forecasting.[16] Hence, current specialisation of regions in a well-defined set of technologies that are close to low-carbon technologies indicate that those regions are more likely to develop a specialisation in the related low-carbon technologies (for example, electrical resistors, capacitors and electric lamps translating into specialisation in solar cells).

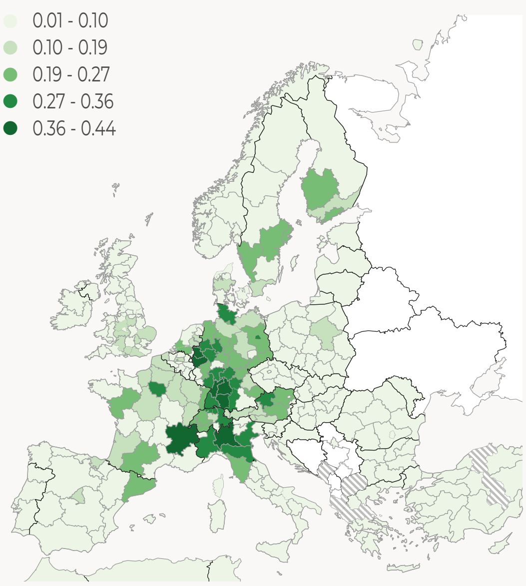
Based on this reasoning we can the identify potential for specialisation in one or more low-carbon technologies in many European regions (see Figure 7 for electric vehicles).

Regions that are already strong in industrial innovation have the best opportunity to also develop a competitive edge in new technology sectors. This is intuitive as manufacturing clusters with advantages including high-skilled labour, universities and good infrastructure will have the best preconditions to develop new strengths. But, some regions with less sophisticated innovation systems also exhibit specific potential in low carbon technologies. For example, Western Finland and Masovia (PL) show up as relatively strong in potential for electric vehicle patenting. Nevertheless, allowing less-developed regions of the European Union to benefit from a surge in low-carbon technologies will remain a challenge.

Early action can help to translate this potential into an actual competitive edge

Countries that invest more in deployment and in public R&D in low-carbon technologies are found to innovate more in these technologies several years after these investments (see Peruzzi and Zachmann, 2015). Hence, it is plausible to assume that early action can help regions that have potential to translate this potential into an actual specialisation. Accordingly, many European regions might benefit from public policy that nudges them towards the growth sectors of the future. On the question of which concrete policies can most efficiently strengthen regional specialisation in low-carbon sectors, more research is still needed. But we would assume that more stringent climate targets can play an important role: creating a predictably growing market for low-carbon technologies enables companies to invest not only in production of the current generation of low-carbon products, but also gives them a strong incentive to put money into innovation in the next generation of low-carbon technologies. If targets can be met with existing technology, there might be less pressure to take riskier bets on disruptive innovation. Hence, a credible commitment to ambitious targets can contribute to transforming regional potential into an actual competitive edge.

Figure 7. Map of the potential Revealed Technological Advantage (2018) for NUTS2 European Regions in electric vehicles



Source: COP21 RIPPLES based on Patstat

The financial-sector case for speeding up[17]

Delaying action to after 2030 poses an even greater risk to financial stability

A failure to increase 2030 emissions reduction ambitions poses greater risks to the stability of the global financial system. From a financial point of view, climate change presents a complex set of systemic risks. The 1.5°C emission pathway[18] requires a major shift in investment patterns and a financial system aligned to the mitigation

16 Huberty, M. and Zachmann, G. (2011). Green exports and the global product space: prospects for EU industrial policy (No. 2011/07). Bruegel working paper.

17 The content of this section has been provided by Bianka Kretschmer (Climate Analytics).

18 IPCC's 1.5°C Report.

challenges. Annual investments in low-carbon energy are projected to average $0.8 trillion to -$2.9 trillion a year to 2050, overtaking fossil investments globally already by around 2025. Current NDC pathways up to 2030 will not drive these systemic changes and create a lack of regulatory certainty and policy commitment that will fail to stimulate the necessary low-carbon investments. Investment in fossil fuels over last few and next few years will likely need to be retired before the capital investment is recovered, or before the end of their operational lifetimes, becoming stranded assets (Rogelj *et al.*, 2018).

These implications expose the financial sector to two types of climate-related risks, with varying effects on specific sectors and industries: 1) physical risks stemming from the increasing frequency and severity of physical climate impacts, which damage physical infrastructure and affect the value of assets; and 2) transition risks caused by policy, technology and market shifts to reduce GHG emissions that will lead to a re-evaluation of assets in a low-carbon economy. Overinvesting in fossil fuel-dependent energy systems will lock in reliance on fossil fuels and result in large-scale stranded assets and accumulated financial risk globally (TCFD, 2017).

Not ramping up climate ambition in the next decade and delaying action until after 2030 will increase the disruptive effects for the financial sector stemming from physical and transition risks, compared to a 1.5°C scenario in which climate policy is enacted smoothly and with immediate effect. Implementing the *Task Force on Climate-related Financial Disclosures* (TCFD)[19] recommendations, the UNEP Finance Initiative finds that delayed global climate policy action will result in additional policy and transition costs of at least $1.2 trillion over the next 15 years for a portfolio of the 1,200 largest companies and investors, with major differences between sectors (i.e. high transition risk for emission-intensive and extractive industries, utilities, and transportation). This only counts asset value losses from increasingly stringent climate legislation, such as setting a price on carbon, without considering large-scale asset value losses from increased physical impacts that result from accumulated GHG emissions, which will also be felt more strongly after 2030 (UNEP FI, 2019).

19 UN Environment Finance Initiative (UNEP FI) to develop recommendations for voluntary climate-related financial disclosures that are consistent, comparable, reliable, clear and efficient, and to provide decision-useful information to lenders, insurers and investors. See *https://www.fsb-tcfd.org/.*

The nexus role of the financial sector as an enabler for higher climate ambition

The COP21 RIPPLES research approaches the financial sector as a key sectoral system. We find that the financial sector has a particularly high need for EU-wide and international cooperation and governance because of its global reach and impact on other sectors in the real economy. This means that financing the transition in order to stay within a 1.5°C temperature rise, and implementing Article 2.1(c) of the Paris Agreement, require reliable policy and regulatory frameworks through decarbonisation targets in different sectors and specific measures targeted at the financial sector itself.

This Agreement [...] aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by [...] making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development."
Paris Agreement, Article 2.1(c) (UNFCCC, 2015)

This goal, which has been championed by the EU, requires action to increase low-carbon investment and phase out carbon-intensive investment. This does not mean that all investment must achieve explicitly beneficial climate outcomes, but investment must reduce the likelihood of negative climate outcomes (UNFCCC, 2018). For example, new investment in unabated coal power plants, upstream oil and gas production, coal mining and new infrastructure for fossil fuel transport, undermines the goals of the Paris Agreement and can be considered Paris-misaligned investment. Tracking progress towards the Article 2.1(c) goal will be part of the Global Stocktaking exercise under the Paris Agreement, scheduled for 2023. The process for updating NDCs provides the opportunity to reflect on the role of the financial sector in enhancing mitigation ambition by 2030 and beyond, and to send a clear signal that can trigger the financial sectors evolution.

To avoid stranded assets and economic disruption in the EU, it is urgent to increasing low-carbon investment and phase out fossil-fuel investment

Climate-related financial risks, especially policy and transition risks, and investment needs become most apparent at the sectoral level. This is shown by COP21 RIPPLES's quantitative analysis of the power sector across EU countries for the periods between 2014-2030 and 2030-2050 (Sferra and Schaeffer, 2019). The following investment-related modelling results are found for the more ambitious 'beyond 2°C scenario':

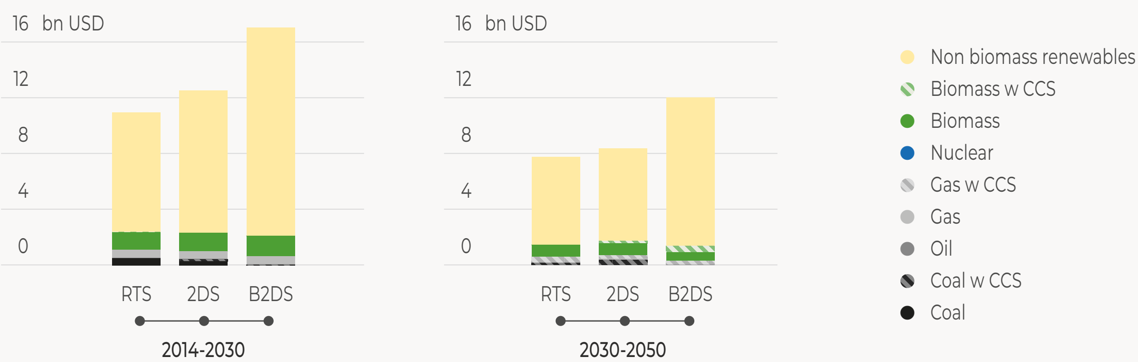
- In all scenarios, 2025 would be the end date for investment in unabated coal plants in the EU. Results show that under a beyond 2°C scenario, fossil-fuel investment (both with and without CCS) will drop to (nearly) zero after 2030 in almost all European countries.
- Projected annual investment in electricity generation from 2014 to 2030 is on average higher than in the period 2030-2050. This is also because of the declining capital cost of renewables, as cumulative capacity increases over time (assuming a 20% learning rate).
- Furthermore, the beyond 2°C scenario projects substantially higher low-carbon investment, reflecting the faster retirement of operating fossil-fuel power plants. This would require additional investment, especially in countries that are currently heavily reliant on coal plants. In Poland, for example, investment between 2014 and 2030 would be twice as much as that required in a Reference Technology scenario. This transformation is challenging and requires clear policy signals to foster the development of renewables and other low- or negative-emission technologies.

A delay in the required EU-wide and global investment shifts to after 2030 would imply an even faster reduction in fossil-fuel investment and a rapid devaluation of assets, rather than a gradual and predictable investment shift. The current EU NDC continues with policy commitments and signals for investment that are financially unsustainable, thereby further increasing the so-called 'carbon bubble' and the risk of stranded assets at a scale and speed that are likely to become unmanageable. Enhancing the EU's NDC is an opportunity to align policy and regulatory frameworks to provide predictability to the financial sector and enable the shift towards Paris Agreement-consistent financial flows.

Conclusion

In this paper, we have made various arguments why the EU's emissions reduction goals for 2030 should become more ambitious. Section 1 provided evidence that delayed action would result in inefficient pathways, with greater social, economic and political risks. Section 2 argued that without ramping up efforts early on, the EU will not contribute its fair share, and the long-term global warming objectives of the Paris Agreement might not be achieved. Section 3 highlighted the importance of ambitious targets for the EU to maintain its leading position in fighting climate change on the international stage. Section 4 showed, based on the example of photovoltaic and lithium-ion battery technologies, that ambitious targets would reduce more quickly the cost of clean-energy technologies, allowing for a faster and smoother

Figure 8. Average annual investments in electricity generation in Germany



Note: Reference technology (RTS), 2°C scenario (2DS) and beyond 2°C scenario (B2DS).

Source: own calculations based on SIAMESE model results.

transition towards a carbon-free economy. Similarly, section 5 made the case for earlier transition on the basis of the benefits it could bring to European industry: some European regions are specialised in clean technologies, and many still have the potential to specialise. Finally, section 6 underlined the huge costs that would stem from low-ambition goals for the financial sector, when assets relying on fossil fuels reduce in value or end up stranded. This multidimensional analysis provides, we believe, a compelling justification for ramping up the EU emissions reduction targets. This would require looking at sectoral details at Member State level to identify where the deepest cuts are possible and to identify the best opportunities and possible challenges, in order to inform the EU discussion on its NDCs and Long-Term Strategy. This can be done by building on the existing EU institutional framework of National Energy and Climate Plans and national Long-term Strategies, if they are both considered together. Many benefits stand to be reaped, and many risks can be avoided.

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The COP21 RIPPLES project

"COP21: Results and Implications for Pathways and Policies for Low Emissions European Societies” aims to analyse the transformations in the energy systems, and in the wider economy, that are required in order to implement the Paris Agreement (NDCs), and investigate what steps are needed to attain deeper, more ambitious decarbonisation targets, as well as the socio-economic consequences that this transition will trigger.

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