A SECTORAL PERSPECTIVE TO EMBARK ON TRANSFORMATIVE PATHWAYS

Objective: Making the case that a sector-based approach is essential to unlock the barriers to reach the objectives of the Paris Agreement and should therefore be adopted for revision of NDCs.

KEY MESSAGES

- Delaying action implies a triple burden: doing more later, being less prepared for it and paying more, besides being a fundamental matter of feasibility to meet the Paris Agreement mitigation goals. Increasing pre-2030 ambition leads to a smoother, more realistic transition; it avoids relying on more intense rates of decarbonisation later, or asking comparatively more of a specific sector, which may increase acceptability problems. Higher pre-2030 ambition offers an opportunity to reduce the overall cost of the transition through 'learning by doing' and avoids locked-in investments.

- A sectoral country-driven approach to decarbonisation is more likely to deliver ambition that is compatible with the goals of the Paris Agreement and can make transformation happen on the ground. This approach can be supported by advancing international governance mechanisms in sectoral terms, and periodic review mechanisms structured by sectoral themes.

POLICY BRIEF

OCTOBER 2018

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This brief compiles research from Deliverables D2.1, D2.3, D2.4, D3.3, D4.1 and D4.2 as well as modelling work performed under WP3. All this work involves the following institutions: Bruegel, Climate Analytics, CMCC, CNRS, COPPE-UFRJ, ERC-UCT, IDDRI, IES-VUB, UCL, TU and WI. This brief has been coordinated by IDDRI.

Cite this report as

COP21 RIPPLES Consortium (2018). A sectoral perspective to embark on transformative pathways. COP21 RIPPLES, Policy Brief.

Context

Parties to the Paris Agreement have agreed to continuously raise the ambition of their mitigation commitments over time, through 5-yearly successive Nationally Determined Contributions (NDCs). The first deadline for all Parties to submit new or revised NDCs is 2020.[1] The expected progressive increase of collective ambition and action is essential to ensure alignment with the Agreement's long-term temperature goal: holding global temperature increase to well below 2°C compared to pre-industrial levels, and pursuing efforts to limit warming to 1.5°C. The preparation of NDCs every five years will be informed by processes designed to take stock of collective progress, including the Talanoa Dialogue in 2018, and the Global Stocktake every 5 years from 2023 onwards.

This brief provides insights on why and how to ratchet-up national and collective ambition, drawing from research developed to date under the COP21 RIPPLES Project. It makes the case for a sector-based approach, intended to support the revision of NDCs in a way that ensures adequacy between the collective ambition emerging from national mitigation commitments and the Paris Agreement mitigation goals. It also offers insights on the international governance framework that could best support such an approach.

1 Decision 1/CP.21, Paragraphs 23-24

Sectoral transformation pathways for ambition

Ambition can be considered adequate if it helps transform our societies so as to meet the global mitigation goal of the Paris Agreement, codified in its Article 4.1 as the requirement to reach global GHG neutrality as early as possible in the second half of the 21st century. Beyond countries raising their 2030 mitigation targets in revised NDCs, such ambition requires understanding the various drivers of emissions and appraising different policy options. To illustrate alternative pathways to the same end point, COP21 RIPPLES constructed with three different models[2] two global scenarios with the same CO_2 carbon budget until 2050, but with distinct emission profiles over time.[3] This allows us to examine implications of increasing ambition before 2030. The first scenario posits that the current global level of NDC ambition is not increased before 2030 ("Current-NDCs"[4]), while the second describes an enhanced ambition tra-

2 For the analysis underlying this brief, COP21 RIPPLES used three different models: ICES (developed by CMCC), TIAM-UCL (developed by UCL) and POLES (developed by GAEL/CNRS).

3 The carbon budget for the "Current-NDCs" and the "Enhanced-NDCs" scenarios across the three models is in the range of 1.000-1.100 $GtCO_2$ for global energy CO_2 emissions (rounded to nearest 50) for the 2010-2050 period.

4 "Current-NDCs": Averaged carbon budget (CO_2-energy emissions only) is 1,050 $GtCO_2$ (rounded to nearest 50). Global emissions level in 2030 (CO_2-energy emissions only) is between 36 and 40 $GtCO_2$, which represents the level of global ambition of the set of NDCs submitted to the UNFCCC. This scenario does not represent individual NDCs, but the global emissions level estimated to be reached if all NDCs are met. According to SR15, such level of emissions in 2030 is out-of-the range for "no- and low-overshoot" 1.5°C scenarios.

jectory for which global emissions level in 2030 have been reduced significantly (relative to "Current-NDCs") ("Enhanced-NDCs"[5]). Both scenarios emit the same amount of cumulative CO_2 energy-related emissions from 2010 to 2050, but the size and timing of emission reductions over time is different. This would lead to higher emissions in 2050 for the "Enhanced-NDCs" as well as different sectoral emission profiles. The following sections summarize the implications of each scenario.

Alternative high-level characteristics of transformative pathways

Looking only at the global emission trajectories is not sufficient to understand the challenges and opportunities associated with different levels of ambition. Policymakers should also characterize the content and nature of the transformations underlying ambition.

Going beyond the traditional emissions gap analysis, COP21 RIPPLES has assessed both scenarios using the "decarbonisation wedges" approach,[6] which analyses the content of the underlying transformations in terms of activity development and structural changes to the economy at the sectoral level.[7] In both scenarios, the growth of sectoral activity drivers, in parallel to the rise of living standards in emerging and developing countries, is a key driver of emissions. In the "Current-NDCs", for instance, the impact on emissions of activity growth in 2030 is three times the impact of the mitigation efforts on energy efficiency or energy decarbonisation.

Both scenarios have common traits: the decarbonisation of energy makes an important contribution to emission reductions only after 2030, for instance. This is because the introduction of new energy vectors (e.g. electric vehicles or the hydrogen economy) will inevitably require the development of new infrastructure, which takes time.

The comparison of both scenarios also highlights very different dynamics in terms of energy intensity and energy decarbonisation. Under the "Current-NDCs", the rate of decarbonisation of the energy system until 2030 is about half of what is achieved under the "Enhanced-NDCs". For the

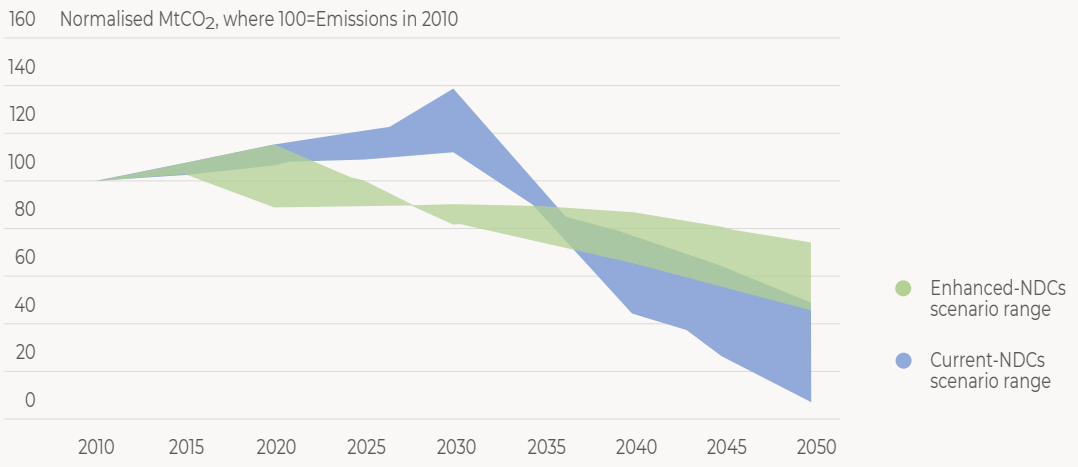
5 "Enhanced-NDC": Averaged carbon budget (CO_2-energy emissions only) is 1,050 $GtCO_2$ (rounded to nearest 50). Global emissions level in 2030 (CO_2-energy emissions only) is between 24 and 26 $GtCO_2$. approaching 2030 emissions levels in low-overshoot 1.5°C pathways assessed in IPCC SR1.5 as explained in its SPM.

6 More information on the approach at Mathy, S., Menanteau, P., & Criqui, P. (2018). After the Paris Agreement: measuring the global decarbonisation wedges from national energy scenarios. *Ecological Economics*, 150, 273-28.

7 The analysis was conducted for different spatial scales: globally, EU-27 and national level for Germany, France, Italy, Poland and the UK.

Figure 1. Illustrative pathways of global "Current-NDCs" and "Enhanced-NDCs" scenarios

Illustrative pathways of the "Current-NDCs" and "Enhanced-NDCs" scenarios for global CO_2 energy-related emissions as modeled by three different models: TIAM-UCL, POLES and ICES



Source: COP21 RIPPLES

"Current-NDCs" to then meet the carbon budget to 2050, the mitigation effect needed in the 2030-2050 period would need to be *five times* higher than during the 2010-2030 period. By contrast, efforts over 2010-2030 in the "Enhanced-NDCs" would be comparable to those over the 2030-2050 period in that same scenario.

With regards to the demand side, energy efficiency equally contributes to emission reductions in both scenarios (about 20%, compared to 2010 emissions) in the 2010-2030 period. Between 2030 and 2050, the role of energy efficiency remains approximately the same as in the first period, with a slight decrease in the "Enhanced-NDCs".

Overall, the mitigation efforts (in terms of tCO_2) in the "Current-NDCs" between 2030 and 2050 are more than twice the efforts implicit in the "Enhanced-NDCs". This implies higher pre-2030 ambition corresponds to a smoother transition, and on that basis, it could be seen as more feasible. These results hold true for all the individual countries analysed in the study, the European Union as a whole, and at the global level.

In addition, since the timing and pace of decarbonisation is different in each scenario, they have different cost implications. The delay in "learning by doing" induced by the moderate deployment of low-carbon technologies during 2010-2030 in the "Current-NDCs" means these technologies will remain more expensive during 2030-2040 than in the "Enhanced-NDCs". Research in the framework of COP21 RIPPLES[8] reinforced the finding that front-loading deployment and public R&D in low carbon technologies can speed up learning and reduce the cost of low carbon technologies. Such initial investment into "learning" can not only speed up the transition but also allow to reduce the long-term total cost of decarbonisation.

Diverse roles for individual sectors

Global "Current-NDCs" and "Enhanced-NDCs" scenarios constructed with three different models show increasing ambition would not be homogeneous across sectors, and requires a sector-by-sector assessment of potentials and transformational needs.

The different levels of emissions reductions associated to the same level of global ambition illustrate that it is just harder to reduce emissions in some sectors than in others. This is because of the individual sectors and sub-sectors intrinsic system inertias and diverse costs. Moving from "Current-NDCs" to "Enhanced-NDCs" also affects sectors differently.[9] This would also be the case for different geographical scales (see some insights for the EU in **Box 1**).

Box 1. Sectoral analysis of EU ambition

Increasing EU ambition requires sector-specific approaches. By highlighting projected sector-specific changes, these results can inform and facilitate the adoption of country-specific approaches. Downscaling a sectoral pathway at the country level offers an opportunity to strategize transformation at the national level.

COP21 RIPPLES has examined the sectoral approach into a specific territory: the EU. The study* provides sectoral insights to inform the revision of NDC based on a quantitative analysis of the IEA/ETP 2017 scenario. Current EU28 policies and pledges fall short of what is needed under a Paris Agreement compatible pathway in the transport sector, while they seem more in line in the power sector. Existing coal-based power plants are likely to become costlier than renewables leading to an early phase-out or declining utilization rates. Therefore, countries that are currently heavily reliant on coal, such as the Czech Republic and Poland, would need to quickly transform their power sector—not merely from a mitigation perspective, but also in support of economic development, in the context of a general coal phase-out within the EU. Similarly, for transport, a strong increase of electrification rates and additional technologies would be essential, which emphasizes the need for R&D investments. The details of the transport sector strategy, such as the respective roles of electrification or biofuels, will partly depend on the countries' choices.

* See COP21 RIPPLES Deliverable D2.3

Model results show that the increase in ambition leads to a change in energy-related emission trends across all sectors during the 2020-2030 decade: the peak of the emissions generally moves towards 2020 for all sectors in "Enhanced-NDCs", except for the agriculture sector which is stable across scenarios. However, these headline trends to 2030 can mask significant differences.

All models show that the emissions of the electricity sector would be significantly reduced in 2030 in the "Enhanced-NDCs" (between 35 and 67% compared to the "Current-NDCs"). The sector's global emissions level in 2030 would be up to 30% lower than 2010 levels in the "Enhanced-NDCs". In fact, the decarbonisation of the power sector accounts for the lion's share of the decarbonisation effort to 2030 (47% in "Current-NDCs" and 38% in "Enhanced-NDCs" using the decarbonisation wedges approach), with quicker and more important reductions in coal and gas generation in the "Enhanced-NDCs", and an earlier penetration of onshore wind and nuclear.[10] In the "Current-NDCs", the substitution of coal and gas[11] makes a large contribution to decarbonisation efforts after 2030, but the decrease in coal generation for coal-intensive countries is not as gradual as in the "Enhanced-NDCs".

The acceleration of the decarbonisation of electricity allows for a wider number of low-carbon options in demand sectors, which contributes to smothering the transition. The largest differences at sector level between the "Current-NDCs" and the "Enhanced-NDCs" scenarios until 2030 are on one hand the energy-related emissions in the services, residential and industry sectors, and on the other one transport (acc. to the TIAM model) or electricity (acc. to the POLES model).

For the industrial sector, the "Enhanced-NDCs" leads to a reduction of 33-42 percentage points in emissions by 2030 compared to the "Current-NDCs". This would be distributed differently among sub-sectors, capturing the heterogeneities of potentials, challenges and opportunities for early mitigation actions. Results[12] show the largest increases in ambition in the non-metallic mineral industry[13] (-52% compared to "Current-NDCs"), which includes the cement industry for example, followed by chemical (-37%) and other industries (-40%). In contrast, steel, chemical industry and other industries see well below average increases in ambition when moving from "Current-NDCs" to "Enhanced-NDCs". Actually these are the sub-sectors which reduce or have the most modest increases in emissions by 2030. For example, the steel sector decreases by 11% its emissions in 2030 compared to 2020 in the "Current-NDCs", showing earlier action permits less intense action in the future. The increased ambition in 2030 has direct consequences for all the industrial sub-sectors paths to decarbonisation up to 2050: for instance, POLES-modeled emissions need to be reduced by 2% annually as average in 2030-2050 in the "Enhanced-NDCs", while this rate is about 7% in the "Current-NDCs". For 2010-2030, average annual reductions would be below 2% in both scenarios.

Transport results vary across models. ICES- and POLES-based analysis reveal a relatively small change in trends before 2030 for the transport sector in the "Enhanced-NDCs". In contrast, TIAM shows a significantly different pathway for the transport from 2020 until 2050, with a 31% increase in ambition by 2030 in "Enhanced-NDCs" followed by a modest ascending trend of emissions until 2050 (with sector emissions being compensated by reductions in other sectors).

Increasing ambition prior to 2030 makes the task of reducing emission later somewhat less daunting, but also allows for certain deferral of the year when carbon neutrality is to achieved to meet the Paris mitigation goals. This is key for some sectors that are difficult to decarbonise. For instance, emissions in the industry sector in 2050 would be higher in the "Enhanced-NDCs" by about 20-50% compared to the "Current-NDCs". The outstanding CO_2 emissions in 2050 for energy intensive industries would be about 54% of 2010 emissions (acc. to ICES-model). For the electricity sector, in spite of large differences in 2050 emission levels across the "Current-NDCs" and the "Enhanced-NDCs" scenarios (ranging between 1 and 4 $GtCO_2$ across

8 See COP21 RIPPLES Deliverable D3.3

9 There are a number of common findings across the results of the three different models, but also significant differences, which point to the importance of assumptions and model characteristics for the sector-based analysis.

10 Before 2030 solar remains less competitive than wind and nuclear considering POLES cost assumptions and POLES learning by doing impact on costs.

11 To note that in "Current-NDCs" gas partly replaces coal.

12 Results at sub-sector level are provided by the POLES model.

13 In the detailed POLES demand model for the main countries or regions, the consumption of energy is divided into 11 different sectors, which are homogenous from the point of view of prices, activity variables, consumer behaviour and technological change. Industry includes four sub-sectors: steel, chemical (+feedstock), non-metallic mineral and other industries (+non energy use).

models), the remaining CO_2 emissions are relatively smaller than other sectors.
These results show that framing the appraisal of ambition in terms of sectoral transformation demands a long-term view, which, in turn, informs what is desirable in the short term.

Creating a conversation centred on development and innovation

The effective way to increase national ambition is for this effort to be articulated with the countries' development objectives. Sector transformative pathways can open the door for a discussion framed in terms of economic and social progress, for instance, developing comparative advantages and increasing supply security.

Alternative decarbonisation pathways imply different relative efforts from sectors at the country-level, but countries have different strength in individual low carbon technologies. COP21 RIPPLES has investigated the countries' comparative advantages in export and innovation for 14 low-carbon technologies, including how strength in existing sectors might spill-over to low-carbon industries. For example, current specialisation patterns suggest that Brazil could seek to extend its comparative advantage in the wind industry and that this might even allow the country to develop a value chain that allows for sustaining jobs, value added and exports. Past development of low-carbon technologies in emerging and developing countries shows the importance of other development objectives in driving innovation. For instance, the South African and Brazilian case studies demonstrate how a renewable energy industrial policy, and the support for wind energy in particular, was rooted in both countries in domestic discussions about energy security, spurred by power shortages in 2001 in Brazil and 2008 in South Africa. The deployment of wind power technology was then fostered by development-driven policies, including local content requirements aiming at domestic job creation. In China, the development of solar PV is rooted in the 13th Five-Year Plan for the Development of Strategic Emerging Industries, which can be traced back to concerns over economic development, as well as air pollution and water quality associated with the overconsumption of fossil fuels. This confirms that the sector transformation analysis allows for the identification of development opportunities beyond greenhouse gases (GHG) emission reductions only. In doing so, a conversation is established beyond the climate community.

Adequate enabling governance

An enabling international governance landscape, both inside and outside the UNFCCC, can support the development and deployment of sectoral policies; it requires a common understanding of the strategic interests associated with a given sector's transformation.

Inter- and transnational governance can support sectoral decarbonisation through five functions: providing guidance and signal; agreeing rules and standards; ensuring transparency and accountability; providing means of implementation; creating and disseminating knowledge. The relevance of these functions varies significantly across sectors. Individual sectors possess unique dynamics and face specific transformation challenges. Global climate governance should therefore help advance tailor-made sectoral approaches.
COP21 RIPPLES has examined to what extent the current post-Paris climate governance landscape fulfils these five functions for key sectors. The UNFCCC provides transparency and guidance at the aggregate level, but it lacks sufficient granularity to meaningfully inform sectoral transformations. Beyond the UNFCCC, there is a myriad of climate governance initiatives which create a polycentric and bottom-up landscape. The broader "institutional complex" can support the development of consistent sectoral visions, but to fully realise its potential they should be better coordinated in a sectoral manner.
Parallel to the analysis of the physical transformations at sector level, this research identifies governance gaps in seven key sectoral systems for the aforementioned five functions.[14] It finds that across sectors, the gap is most serious in

14 Power, energy intensives, extractive industries, finance, international transport, land-based transport and buildings.

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. **Box 2** illustrates the case of the financial sector.

Implications for the Talanoa Dialogue and the review of NDCs

Country-driven analyses of sectoral transformations are essential to inform ambitious emissions pathways aligned with the Paris Agreement's global mitigation goals. These analyses should set the agenda for the development of long-term low GHG emission development strategies and the revision of NDCs. Under these terms, the adequacy of ambition can be evaluated against two dimensions: compatibility with the global long-term goals and capacity to be implemented.

A clear understanding of the transformations needed at sectoral level is a prerequisite to shape a transformative ambition, and avoid a simple incremental increase of NDC mitigation targets that may not lead to the committed long-term goals. The sectoral approach also facilitates the concrete link to development as it starts from the tangible measurement of development in the form of activity levels and access to services. In addition, understanding development and activity patterns is central to identify the solutions that make most sense in a given country context, delivering both sustainable development and emission reductions. Research to date under COP21 RIPPLES highlights that attention should be paid to the areas with the largest decarbonisation need and potential, developing new energy vectors and accounting for technological, structural and infrastructural path dependencies. Specific governance measures should also be put in place to support these sectoral approaches to decarbonization.

Ambition emerging from country-driven sector-based approaches is more likely to make transformation happen on the ground. This is explained by the engagement of actors that have a stake in the development of different sectors resulting from a clear understanding of the required sectoral transformation and associated risks and benefits.

Box 2. The nexus role of the financial sectoral system

The financial sector holds a central role in international discussions. COP21 RIPPLES research* [argues for a sectoral analysis of the international governance regime to include the financial system as a distinct sector, with its own governance demands. Specific sectors possess their own investment needs, shown clearly by quantitative analyses under COP21 RIPPLES** on the power sector across EU countries, which finance can help to fulfill *via* sectoral-targeted actions. Under this approach, finance works as an enabler to such needs.

However, Paris Agreement's Article 2.1(c) goes beyond this enabling role, assigning to all financial flows an objective of sustainable development and decarbonisation. COP21 RIPPLES research*** demonstrates that the financial sector displays a particularly high need of coordinated international governance, due to its global reach and the impact of its governance on different sectors in the real economy. Finance has a central role in the delivery of other sectoral transformations, and therefore needs to deliver functions related to guidance and signal, rule setting to facilitate collective action, transparency and accountability, and knowledge and learning. In order to effectively deliver these functions, the financial sector needs to undergo multi-level (global and national) systemic transformations to reallocate all its flows towards low-carbon investments that are compatible with long-term climate and sustainable development targets.

* See COP21 RIPPLES Deliverable D4.1
** See COP21 RIPPLES Deliverable D2.3
*** See COP21 RIPPLES Deliverable D4.2

Based on the above findings, the Talanoa dialogue in 2018 provides the opportunity to discuss the alignment of decarbonisation and emission reduction commitments reflected in NDCs with the Paris Agreement long-term temperature goal. This could include discussions on advancing international governance in sectoral perspectives. This in turn may assist countries to specify sectoral and even sub-sectoral visions toward decarbonisation, in the context of building political momentum from the Talanoa dialogue, enhancing the level of mitigation ambition in NDCs, and mobilising greater finance and capacity-building.

The Talanoa Dialogue process, through its approach of integrating various actors from the broader climate regime complex outside of the UNFCCC, has high potential for making use of the UNFCCC's orchestrating role in order to contribute to addressing the identified governance gaps in guidance and signal, as well as enhancing collective action, on a sectoral level. Continuous efforts need to be made for all sectors to be represented, including the financial sector, which should provide information on financial flows and measures to align them with the Paris Agreement and the SDGs. The explicit sectoral pathways can provide the clarity and transparency sought by private investors. Redirecting financial flows towards low-emission and climate-resilient development pathways, in line with Article 2.1(c) of the Paris Agreement, could provide additional resources and unlock barriers for the necessary investment in decarbonisation measures in all sectors. Updating NDCs provides the opportunity to reflect on the role of the financial sector in enhancing mitigation ambition.

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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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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730427 (COP21 RIPPLES)