ACT DDP

ASSESSING COMPANY TRANSITION with DEEP DECARBONIZATION PATHWAYS

Methodological note:

The DDP initiative, framework and reporting template

Version 1.0 --- February 2021

Project partners

RÉPUBLIQUE FRANÇAISE Liberté Egalité Fraternité

ADEME AGENCE DE LA TRANSITION ÉCOLOGIQUE

IDDRI

CDP DISCLOSURE INSIGHT ACTION

COPPE UFRJ Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia

TEMPUS ANALITICA

Supported by

FONDS FRANÇAIS POUR L'ENVIRONNEMENT MONDIAL

Table of contents

1. The DDP initiative – an international research community informing national and international policy debates on sustainable transformations compatible with the global 1.5°C target

1.1. Background and network

Formed in October 2013, the Deep Decarbonization Pathways Project (DDPP) issued a report on the first phase of its work at the United Nations Climate Summit in September 2014, at the invitation of Secretary General Ban Ki-moon, before the COP 21. In the fall of 2015, research teams from 16 of the countries producing the largest amount of carbon emissions were involved in the DDP research community and were publishing stand-alone reports describing in greater detail their research proposed decarbonization pathways for their economies and brought them to the domestic and international debate[1]. These efforts contributed to the China-USA dialogue ahead of COP21 and to the mention of "long-term low emission development strategies" in Article 4.19 of the Paris Agreement.

Today, the DDP initiative[2] aims at extending its work to new countries, strengthening the relevance of sectoral analysis and encouraging domestic and international debate. To this end, the initiative is conducting a number of projects covering different geographical areas and topics. Special efforts are made to ensure that its findings are available to all, in the most relevant and user-friendly way. The Deep Decarbonization Pathways (DDP) initiative represents now a global collaboration of leading research teams currently covering more than 40 countries (See figure 1).

Figure 1. The DDP Network is present in more than 40 countries. Map in 2018. Link to the members: ddpinitiative.org

[1] https://www.iddri.org/en/project/deep-decarbonization-pathways-project

[2] www.ddpinitiative.org

1.2. Objectives and contributions

Keeping global warming well below +2°C and towards +1.5°C requires immediate changes, through choices that lead our economies towards a carbon neutral world by the second half of the century. We know what we want to achieve: the challenge lies in determining how to do it, and what is the necessary sequence of actions. Countries, cities, companies need to put in place strategies that satisfy the needs of the people in a way that is compatible with climate change targets.

The aim of the DDP community is to help governments and non-state actors make choices that put economies and societies on track to reach a carbon neutral world by the second half of the century. Together, they:

1. Build and open to debate ambitious and realistic decarbonization pathways, country by country, showing key drivers and their effects by 2050
2. Make their common methodology available to all, so that every government or stakeholder can build and propose its own pathways
3. Develop in-country expertise and international scientific knowledge.

The DDP initiative contributes to the implementation of the Paris Agreement inviting countries to communicate "long-term low emission development strategies" (LTS). This complements and brings perspective to the revision of countries' official commitments (Nationally Determined Contributions), which occurs every five years. It especially supports the efforts of the Carbon Neutrality Coalition, that brings together national and local governments, as well as private companies committed to a decarbonization path. Public and private financial actors can also use the DDP approach to assess to what extent their strategy supports the decarbonization of the economies they support.

The DDP initiative contributes to the development of research activities able to feed the Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), and in particular its Chapter 4. This contribution occurs through collective publications, such as the 2016 Special Issue of Climate Policy, the 2019 Paper in Nature Climate Change, the 2020 Paper in Climate Policy or the 2020 Special Issue of Energy Strategy Reviews. It also involves the participation of members of the DDP community, such as Henri Waisman, as Coordinating Lead Author of Chapter 5 ("Sustainable Development, Poverty Eradication and Reducing Inequalities") of the IPCC Special Report on a 1.5°C Global Warming or Christopher Bataille, international climate policy researcher.

2. The DDP framework – a science-based and common approach to build policy-relevant deep decarbonization pathways and dialogues

The DDP community develops through their different projects and shares a common approach to design pathway across geographies and focus topics. This is based on a rigorous yet flexible framework that all stakeholders can adopt. This approach is proposed on an open source basis, so that every government or stakeholder can propose and test its own pathways.

The main strengths of the DDP approach are:

- helping to build qualitative narratives around the comprehensive consideration of decarbonization drivers
- translating them into quantified pathways through a combination of analytical methods and expert assessments
- enabling their communication and comparison through standardised outputs in a transparent way.

The comparability is important because it allows a constructive debate among stakeholders with different interests within a country, as well as on an international level. Knowing and understanding the strategies of other countries allows to learn from each other and to identify useful cooperation areas (e.g. joint R&D efforts).

2.1. The scientific foundation of the DDP framework

About deep decarbonization

Global deep decarbonization pathways are those pathways that are consistent with the Paris Agreement, i.e. reach global peaking of GHG emissions as soon as possible and reach net-zero or negative GHG emissions in the second half of the century. This means respecting the physics of deep decarbonization; net emissions to atmosphere of CO_2 must fall to net-zero and become negative where possible, and all the other major greenhouse gases must fall to manageable levels (NOx must fall by one third, black carbon by two thirds, and methane by two thirds). Concerning carbon dioxide specifically, the IPCC report on “Global Warming of 1.5°C” (SR1.5) points out that global neutrality should happen between 2050 (for 1.5°C) and 2075 (for 2°C). It also points out the necessity of minding non-CO2 forcers to maintain the global objective.

The above milestones do not mean that each country should reach full GHG neutrality by 2050. However, given the importance of the countries covered in the ACT DDP project for global emissions, national deep decarbonisation pathways for each country should consider that:

- energy and land-use carbon emissions should tend to zero by mid-century or soon after in all countries, meaning in turn that each sectoral trajectory should be framed by the carbon neutrality approach

- negative emissions from land-use should be enhanced. To achieve the global carbon neutrality objective, the countries featuring the lion's share of world's carbon sink potential would, potentially with international cooperation, feature net negative emissions within their country boundary as soon as possible, no later than 2050. But this cannot be possible unless there is a wide recognition that, because the preservation of these sinks is a necessary condition for achieving ambitious global mitigation goals, it is a collective problem and requires adequate international support to be designed in close collaboration with the countries where these major sinks exist.
- additional net negative emissions may be needed from biomass combusted with CCS, direct air capture of CO2 with CCS, or other direct negative emissions techniques.

A basic rule of thumb[3], is that every country's projected path of annual emissions must fall ~33% per decade for 1.5°C, and ~20% per decade for 2°C, or be compensated with negative AFOLU or technical negative emissions. Given delays in overall energy using equipment stock turnover, and later compensatory investment in much lower GHG intense stock, this suggest rules of thumb of 25-30% reductions per decade for 1.5C, and 15-20% reductions for 2°C.

About the systems' transitions

To reach this scale of emission reductions, profound changes in social, economic, and technological pathways are needed compared to those followed in the past or elsewhere, which should be guided by key conditions that must be satisfied at the national level for all countries:

- Energy and material efficiency in all sectors is maximized, including demand-side, material efficiency and circular economy measures.
- All primary energy sources and energy carriers are decarbonized, and all demands are switched to these carriers; national energy system emissions fall to zero (2050 for 1.5°C, 2075 for 2°C).
- Agriculture and Land Use emissions are minimized and made net negative if possible.
- Countries also need to consider the emissions embedded in imported and exported products (e.g. coal, crude oil and beef).

The SR1.5 highlights that these changes should be considered across the four main socio-economic systems: energy systems, urban and infrastructure systems, industrial systems, land and ecosystem systems. It provides information regarding the characteristics of these transformations in each system to be consistent with limiting global warming to 1.5°C (see statements C.2.2, C2.3, C2.4 and C2.5 of the SR1.5 Summary for Policymakers[4]).

About sustainable development

A key point is that these DDPs are explicitly assessed in the context of sustainable development and efforts to eradicate poverty and reduce inequalities, acknowledging that climate change and development can be considered two sides of the same coin. The entire package of Sustainable Development Goals (SDGs) constitutes the framework for the

[3] Based on own interpretations of IPCC SR1.5
[4] Link to Summary for Policymakers of the IPCC 1.5°C Special Report: https://www.ipcc.ch/sr15/

discussion of global DDPs. According to the IPCC 1.5°C Special Report, limiting global warming to 1.5°C rather than 2°C above preindustrial levels would make it markedly easier to achieve many aspects of sustainable development, with greater potential to eradicate poverty and reduce inequalities (Ch.5, p.447). And, also according to the IPCC 1.5°C Special Report, "mitigation options consistent with 1.5°C pathways are associated with multiple synergies and trade-offs across the Sustainable Development Goals (SDGs). While the total number of possible synergies exceeds the number of trade-offs, their net effect will depend on the pace and magnitude of changes, the composition of the mitigation portfolio and the management of the transition" (see statement D.4 of the SR1.5 Summary for Policymakers).

What is most important for the DDPs is therefore the clear articulation of socio-economic dimensions where achievement of national development goals is prioritized (e.g. with respect to security, poverty, inequality, access to energy, air pollution). Any climate policy objectives must work within these goals to sufficiently provide for development and equity, and so, to preserve social cohesion through the low carbon transition. This requires well tailored policy and sectoral policies and actions that are in accordance with development goals and consider the needs and political direction (i.e. supporting or opposing) of all major stakeholders.

About research on policy-relevant pathway development

Based on the experience of its research members and international literature review, the DDP community identified key methodological challenges for the development of policy-relevant deep decarbonization pathways[5]:

1. **A country-driven and multi-scenario approach** is central to inform policymakers on possible futures and their consequences and enable the development of robust strategy and its adaptation. The different scenarios should be built around the key global and country-specific uncertainties that could affect the country pathway.
2. **Detailed sectoral pathways** is key to inform and monitor some specific policy interventions**.** It requires to describe the different sector-specific underlying drivers going beyond the usual quantitative energy and emission-related indicators of trajectories. One model is not able to structure all these information together, so that a more flexible and inclusive approach to modelling is needed.
3. **Comparable pathways** is important to facilitate knowledge sharing, global comparison and additionability. This requires a systematic, quantitative structure that identifies key sectoral and development metrics and is built to accommodate scenarios from different sources. We refer to this purely quantitative reporting structure as a 'dashboard'.
4. **An iterative and backcasting approach by 2050** is required to identify the compatible short-term actions and consider some systemic changes with profound inertia to reach mid-century development objectives and carbon neutrality.

[5] *A pathway design framework for national low greenhouse gas emission development strategies, Nature Climate Change, 2019, Waisman, Bataille et al.*

2.2. Presentation of the DDP Framework

The DDP framework enables to build a pathway and to represent it with a *storyline* and a *dashboard*. The definition of a consistent development and deep decarbonization pathways requires to go through all the three main steps: the storyline definition considering the full set of decarbonization drivers, its quantification with the possible support of different tools, and its representation into a core quantitative dashboard facilitating analytical check against long-term benchmarks and the iterative process. The graphic pathway visualization further facilitates pathway comparison to contribute to policy debates (see figure 2).

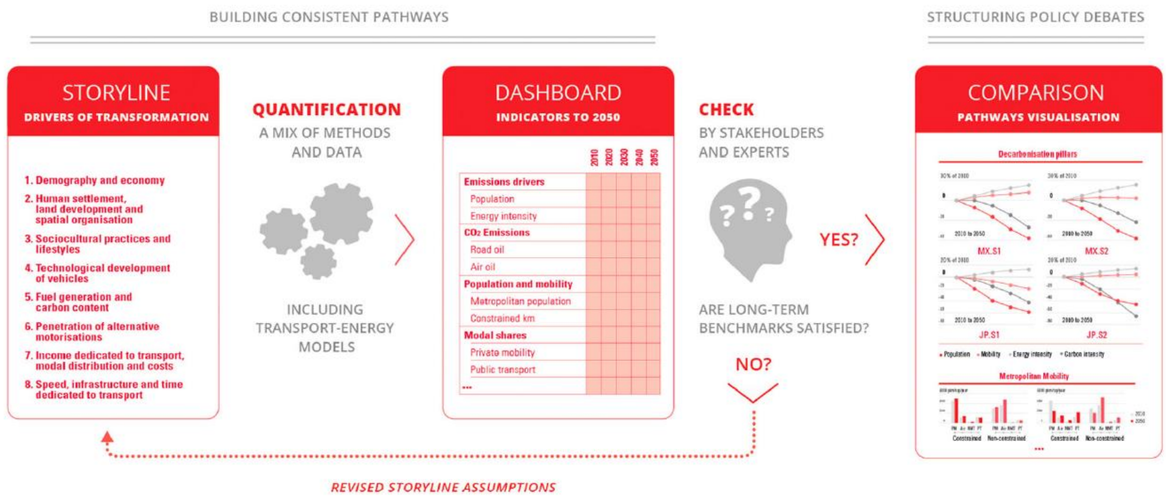

Figure 2. The DDP Framework with sectoral details from the passenger transport sector. Source: Julien Lefèvre , Yann Briand , Steve Pye , Jordi Tovilla , Francis Li , Ken Oshiro , Henri Waisman , Jean-Michel Cayla & Runsen Zhang (2020): A pathway design framework for sectoral deep decarbonization: the case of passenger transportation, Climate Policy, DOI: 10.1080/14693062.2020.1804817

The first component of the approach, the *storyline*, plays a central role and offers a structure to consider the full set of national and sectoral transformations required to transition towards a sustainable world. As the mirror image of the *dashboard*, the *storylines* on the contrary, do not seek to quantify systematically all elements, they are stories "told in words and numbers, describing the way events might unfold". Concretely this means that *storylines* are not only qualitative and should include quantitative information where relevant in order to provide a description that is as explicit and tangible as possible. The choice of the indicators informed quantitatively as part of the *storyline* can be freely chosen by each team based on what makes sense for fleshing out their story, what can be informed in a robust manner and what complement the quantitative vision of the scenario presented with the indicators of the *dashboard*. The quantified information is not necessarily a trend for the full period to 2050 but can be only ballparks, ranges, landing point values in 2050.

In the reporting template described in the part 3, sub-elements and potential indicators are listed for illustration in the *storyline* table but these lists are neither binding nor comprehensive and the teams should feel free to include the elements that they feel relevant. Priority attention should however be given to the indicators that enable direct comparison with information provided in the Summary for Policymakers of the SR1.5 where characteristics of systems' transformation compatible with Paris Agreement ambition are discussed. However, the overall structure of the chapters of the *storyline* has been built with academic researchers to capture all drivers of transformations and enables research teams to consider them in the definition of their pathway, independently of their existing modelling constraints.

Indeed, no single model is able to integrate all dimensions of the *storylines* and many drivers could therefore be excluded of the analysis, not because they are not relevant for the transition but because they are not included in a single modelling tool. Therefore, the approach is built on the logic of reporting a comprehensive set of data in the *dashboard* that includes indicators able to fully include all *storyline*'s dimensions and that can be informed from various sources. This enables the choice of a combination of quantification approaches, "combining results of modelling runs with out-of-the box assessments and other expert-based assumptions". The *dashboard* represents the *storyline* in a standardized quantitative manner. Based on the experience of the DDP country teams, key issues raised in their national contexts were identified to inform the design of a common dashboard and the selection of the convenient indicators. In the end, a limited number of quantitative indicators were structured around main topics to facilitate stakeholders' discussions.

National deep decarbonization pathways (DDPs) are to explain how the "rapid and far-reaching transitions" required globally can happen in each country context "in the context of sustainable development, poverty eradication and reduction of inequalities". Thus, national *storylines* and *dashboards* should describe the building blocks of transformations outcomes specific to the country context in each of the main systems and be comprehensive by those responsible for implementation and those affected by the transformations (e.g. governments, indigenous peoples' organizations, sector associations, firms, energy utilities, unions, experts, households, non-governmental organizations, etc.).

The framework provides economy-wide and sectoral focuses:

- An *economy-wide representation* provides a systematic description of the main building blocks of transformations in all systems, together with a cross-cutting, overarching description of country-level trends. The objective is not to enter into the maximum level of detail (which is rather the purpose of sectoral narratives, see below) but to provide a framework for checking the consistency between the national picture and the composite of the different sectoral transformations.
- S*ectoral representation* provides a deep dive in a given sector, considering more granularity in the drivers of change considered. When a sectoral narrative is designed, it serves to inform the aggregate description of this same sector in the economy-wide narrative. Given its higher level of details, it can also help better characterize the national and international conditions required to support the sector systems' change.

Find more detailed examples in:

- Jim Williams, Henri Waisman (2017): 2050 Pathways: a handbook, 2050 Pathways Platform.
- Julien Lefèvre, Yann Briand , Steve Pye , Jordi Tovilla , Francis Li , Ken Oshiro , Henri Waisman , Jean-Michel Cayla & Runsen Zhang (2020): A pathway design framework for sectoral deep decarbonization: the case of passenger transportation, Climate Policy.

3. The ACT-DDP reporting template – a set of qualitative and quantitative indicators to describe sectoral deep decarbonization pathways and used to assess the company transition

The structure of the reporting template encompasses both *storyline* and *dashboard* information to present: the economy-wide deep decarbonization pathway and sub-sectoral pathways for the power sector, the cement sector and the passenger transport sector for Mexico and the power sector, the cement sector and the agriculture, forestry and land-use sector for Brazil. The systemic and aggregated information presenting the economy-wide picture is presented in annex 1 and the specific sectoral information considered in the ACT-DDP project are further developed below.

3.1. The sectoral pathway description for the power sector

STORYLINE	Short term (i.e. next 1-5 years)	Medium term (2025-2030)	Long term (2030-2040)
Ownership , regulaiton and market structure of electricity prod. &dist.			
Who owns the system? How is it planned and regulated? How are new investments made? How might this change in the scenario to allow electrification, etc. If you use distributed power, how do you enable it?			
Electrificity consumption needs (all sectors)			
% of transport energy being electric (and for other sectors), total growth needs…			
Power plant capacities and caracteristics			
Replacement/addition capacities, Development of renewable capacities, Replacement of coal, gas and liquid fuel power plants, conversion yields and efficiency measures, self-consunption and non-grid capacity, loading factors of technology used, …			

Carbon content of electricity			
Carbon content of primary energy used, use of CCS and BECCS technologies and capacities, share of biofuel and biogas used…			
Grid extension and flexibililty			
Localisation of production capacities and consumption sites and need for transmission lines, Development of large intermittent renewable capacities and needs for grid flexibility measures (network driving, demand-side, storage, fast ramp-up assets…). Use of firm low GHG assets to support network (hydro, fossil+CCS, hydrogen turbines or fuel cells, small or large nuclear.			
Socio-economic conditions of the development plan			
Electricity access, Energy poverty, Rural electrification			
Investment needed over time (cost/installed kW), comparison of LCOE, market mechanisms and regulation to support low carbon power plants, final price of electricity for consumers and companies…			

DASHBOARD		**Starting year**	**2020**	**2030**	**2040**	**2050**
Extract of the Economy-wide DB TAB relevant rows for this sub-sector						
Final Electricity consumption	TWh					
Electricity production	TWh					
Carbon intensity	gCO2/kWh					
Electricity emissions	MtCO2					
Power Generation indicators						
Electricity production by input type						
Coal w/o CCS	TWh					
Coal w/ CCS	TWh					

Gas	TWh					
Gas w/ CCS	TWh					
Liquids w/o CCS	TWh					
Liquids w/CCS	TWh					
Nuclear (large)	TWh					
Nuclear (<300MW)	TWh					
Hydro	TWh					
Wind	TWh					
Solar (utility)	TWh					
Solar (small distributed solar)	TWh					
Biomass w/oCCS	TWh					
Biomass w/CCS	TWh					
Geothermal	TWh					
Other renewables	TWh					
TOTAL	TWh					
Fossil energy input for electricity production, by input type						
Coal	EJ					
Gas	EJ					
Refined products	EJ					
Carbon content						
Carbon content of electricity production	gCO2eq/kWh					
Losses						
Transmission losses	%					
Power Generation capacities						
Generation capacity*						
Coal w/o CCS	GW					
Coal w/ CCS	GW					
Natural gas	GW					
Natural gas w/ CCS	GW					
Fuel w/o CCS	GW					

Fuel w/CCS	GW					
Nuclear	GW					
Hydro	GW					
Wind	GW					
Solar	GW					
Biomass	GW					
Geothermal	GW					
Other renewables	GW					
TOTAL	GW					
Generation capacity additions and replacement						
Coal w/o CCS	GW					
Coal w/ CCS	GW					
Natural gas	GW					
Natural gas w/ CCS	GW					
Fuel w/o CCS	GW					
Fuel w/CCS	GW					
Nuclear	GW					
Hydro	GW					
Wind	GW					
Solar	GW					
Biomass	GW					
Geothermal	GW					
Other renewables	GW					
TOTAL	GW					
Final demand						
Electricity demand by sector						
Residential buildings	TWh					
Passenger Transport	TWh					
Industry (EII)	TWh					

Industry (light industry)	TWh					
Agriculture	TWh					
Commercial buidlings	TWh					
Freight Transport	TWh					
Energy transformation (power-to-X)	TWh					
TOTAL	TWh					

3.2. The sectoral pathway description for the cement sector

STORYLINE	*Short term (i.e. next 1-5 years)*	*Medium term (2025-2030)*	*Long term (2030-2040)*
Transformation of the building sector: future of the demand of cement and concrete			
What are the drivers of the future national consumption of cement and concrete? What is the overall demand rate (growing, shinking) for new buildings and infrastructure? How much concrete is needed, and cement to make it? Is thaere any significant level of imports or exports of clinker? Are there common substitutes for concrete as a construction material?			
What are the drivers of the future consumption of cement and concrete globally? How much trade is expected in clinker?			
Service Demand Reduction: Decarbonisation Driver			
What actions or measures could be taken to reduce services that would also have a corresponding reduction in the demand for cement? For example, can the overall building area required or the service intensity (i.e., demand for building space) be reduced which would also drive down the requirement for cement?			
Material End-Use Efficiency: Decarbonisation Driver			
What actions or measures could be taken to reduce the amount of cement required to meet equivalent lifetime performance or service in buildings and infrastructure? Can less material be used (over design)? Are there optimizations that can be made to reduce concrete demand through component re-use, repair and increasing strength and durability of products trhough better mixing and aggregate packing?			
Are there any ways to reduce the waste of cement in construction?			
End-of-Life and Demand Circularity: Decarbonisation Driver			

What actions or measures can be taken to increase the amount of cement that is recycled at end-of-life? How can recycled cement be used as an input in cement production to substitute virgin material inputs? What other recycled uses for cement can be exploited, particularly for high value chain uses?			
Is it possible to make it easier for end-of-life concrete to be recycled (ease at which cement can be separated and disassembled)?			
Is there any end-of-life treatment that could enhance the carbonation of concrete or re-absorption of CO_2? Carbonation is the reverse of the calcination process used in the production of cement that releases singificant CO_2 emissions. Concrete reabsorbed CO_2 during its life and when broken down and exposed to the atmosphere at end-of-life; it can re-absorb as much as 80% of the original calcination emissions.			
Energy Decarbonisation: Decarbonisation Driver			
What electrification with low carbon electricity is possible, e.g. for grinding? At what cost and how to incentivize it?			
What alternative low GHG fuels are available to replace coal or natural gas as the heating source?			
Are there additional broad fuel policies, e.g. for air quality or carbon reduction, that can drive emissions associated with fuel combustion lower?			
Production Technologies and Processes: Decarbonisation Driver			
What improvements in production energy efficiency could be implemented? How are these improvements incentivized?			
What new technologies with lower carbon intensity of production could be employed? What are the best available technologies (BAT) in relation to ghg emission intensity?			
What fuel switching (to lower carbon emission intenisty fuels) could be completed?			

Are less emission intensive substitutes possible for clinker in cement production, e.g. blast furnace slag, coal or biomas fly ash, or calcined clays? What is the maximum clinker substitution that could be achieved (50% wihtout blast furnace slag?)?			
Non-Technology Production Efficiency: Decarbonisation Driver			
Cement is effectively the glue between sand, gravel and stone aggregates. Is it possible to centralize more of the cement and aggregate mixing so as to minimize space between the aggregates via multi size aggregates (sand, gravel, multi sized stones) and better mixing?			
Are there ways to avoid waste in production processes? For example, produce less scrap and waste and increase the amount of sold product.			
Direct or Indirect Carbon Capture and Storage: Decarbonisation Driver			
Is it possible to capture CO2 from the kilns and sequester the CO2? (e.g., retrofitting existing assets with end-of-pipe technologies and transporting and injecting the CO2 into permanent reservoirs). Technology has also been developed to inject CO2 directly into concrete at the mixing stage where it is re-absorbed (carbonation). This type of carbon capture technology should also be considered.			
Can the clinker production be centralized near appropriate low-cost carbon sequestration sites, and then be either transported to decentralized cement mixing sites, or produced on-site depending on market needs?			
Innovation			
What implications does your scenario for cement production have for innovation? Where do you expect new techniques, processes to emerge: domestically, or somewhere else? What stakeholders will need to contribute? Where could financing come from? What regulatory role is there for national and subnational actors?			
Competitiveness			

How do you see international competitiveness evolving for main sources of industrial emissions? For either regular or low GHG cement do you expect there to be new trade risks (e.g., border adjustment tariffs) or opportunties (export markets?)			
Barriers			
What are the major financial, technical, institutional and regulatory barriers that are there for the identified scenario? What policies, actions or changes in the regulatory environement could help mitigate these barriers?			
Co-Benefits			
What co-benefits could be associated with the scenario? Could they be identifiably linked to the action, so as to help support the action? Co-benefits could include air quality health benefits, economic development and jobs, security, resource efficiency, climate adaptation..			

DASHBOARD		***Starting year***	**2020**	**2030**	**2040**	**2050**
Extract of the Economy-wide DB TAB relevant rows for this sub-sector						
Sectoral cement GDP value	Millions of USD 2015					
Produced quantity of cement	Mt					
Service Demand Reduction	%					
Material Efficiency Demand Reduction	%					
End-of-Life Recycle Rate (%)	%					
Average Clinker Ratio	%					
Energy Efficiency Measure	MJ/t clinker					
Energy Decarbonisation Measure	tCO2e/TJ					
Total Energy Consumption	TJ					

Total Emissions Including Direct and Indirect CCS(U)	MtCO2e					
Factors Driving Demand for Concrete and Cement						
Sectoral construction GDP value	Millions of USD 2015					
Sectoral cement GDP value	Millions of USD 2015					
Total New Residential and Commercial Floorspace	*millions of sq. meters*					
Population	*millions*					
Estimated Demand for Concrete and Cement						
National final consumption of concrete	Mt (Megatonnes)					
National final consumption of cement	Mt					
National final consumption of clinker	Mt					
Imported quantity of cement	Mt					
Imported quantity of clinker	Mt					
Exported quantity of cement	Mt					
Exported quantity of clinker	Mt					
Domestic production cement	Mt					
Service Demand Reduction for Concrete and Cement						
Service Demand Reduction Assumption	%					
Is this Service Demand Reduction Included in Current Demand?	YES					
Material End-Use Efficiency Reduction for Concrete and Cement						
Material Efficiency Demand Reduction Assumption	%					

Is this Service Demand Reduction Included in Current Demand?	YES					
End-of-Life and Demand Circularity: Decarbonisation Driver						
End-of-Life Recycle Rate (%)	%					
Final Demand for Concrete and Cement						
Produced quantity of cement	Mt					
of which exported	% of Mt prod cement					
of which for national use	% of Mt prod cement					
Average Cement to Concrete ratio	%					
Produced quantity of clinker	Mt					
Production Stock and Technology: Clinker Production (Includes energy demand for kiln, pre-heater, calciner etc).						
Clinker production - heat demand intensity	MJ/t clinker					
Clinker production - heat energy emission intensity	tCO2e/t clinker					
Clinker production - industrial process calcination emissions	tCO2e/t clinker					
Cement production emission intensity	tCO2e/t clinker					
Production Stock and Technology: All Other Process Energy Demand (crushing, grinding, conveying)						
All other Process Energy Demand intensity	MJ/t clinker					
All other Process GHG emission intensity	tCO2e/t clinker					
Production Technologies and Processes: Decarbonisation Drivers						
Average Clinker Ratio	%					
Energy Efficiency Measure	MJ/t clinker					
Energy Decarbonisation Measure	tCO2e/TJ					
Energy Consumption						
Clinker production - Final heat consumption	TJ					
of which from coal combustion	TJ					

of which from fossil liquid fuel combustion	TJ					
of which from fossil gas combustion	TJ					
of which from liquid biofuel combustion	TJ					
of which from biogas combustion	TJ					
of which from mix of biomass	TJ					
of which from hydrogen	TJ					
All Other Process - Energy Consumption	TJ					
of which from electricity	GWh					
of which from fossil liquid fuel combustion	TJ					
of which from fossil gas combustion	TJ					
of which from liquid biofuel combustion	TJ					
of which from biogas combustion	TJ					
of which from mix of biomass	TJ					
of which from hydrogen	TJ					
Total Energy Consumption	TJ					
GHG Emissions						
Clinker production - Final heat	MtCO2e					
Clinker production - industrial process calcination emissions	MtCO2e					
All Other Process - Energy Consumption Emissions	MtCO2e					
Total Emissions Including Direct and Indirect CCS(U)	MtCO2e					
Direct or Indirect Carbon Capture and Storage						
On-site CCS(U) net	MtCO2e					
Off-site CCS(U) net	MtCO2e					

3.3. The sectoral pathway description for the passenger transport sector

STORYLINE	Short term (i.e. next 1-5 years)	Medium term (2025-2030)	Long term (2030-2040)
Demographic and economics			
- Population structure (size, age, working pop) - Economic situation (GDP, wealth distribution, household revenues)			
Human settlement, land development and spatial organization			
- Human settlement and development of metropolitan areas (concentration/ desertification, urban sprawl/ densification) - Land use planning (distribution of human activities, mixed/ specialized) - Urban forms and transport organization (distribution of space between modes)			
Sociocultural practices and lifestyles			
- Leisure preferences (non-constrained km, long distance travel) - Teleactivities development (home-work km) - The place of car (car ownership) - Digital use and new connected transport practices (carpooling, carsharing, on demand transport) - Other important sociocultural aspects (comfort, security, social status, driving experience...)			
Technological development of vehicles			
- Individual mobility (Car, 2W) technologies and fuels available (when, which purchase costs, energy consumption) - And for other vehicle: bus, train, air			
Fuel generation and carbon content			

- Fuel needs and assets of production (infrastructure for agrofuels (liquid/gas) production, electricity production, sustainable constraints on agrofuel prod) - Fuel prices, carbon content			
Penetration of alternative motorizations and car stock			
- Car purchase price for the different technologies - car ownership model - penetration in rural and urban areas			
Income dedicated to transport, modal distribution and costs			
- Household expenditures dedicated to mobility - modal costs and relation with modal choices			
Modal speeds, infrastructure and time dedicated to transport			
- Modal infrastructures in cities - Modal infrastructures for intercity mobility - Modal infrastructures for international mobility (to connect with 2.human settlment) - development of congestions and modal speeds - Time constraint, speeds, distance and modal choices			

DASHBOARD		**Starting year**	**2020**	**2030**	**2040**	**2050**
Extract of the Economy-wide DB TAB relevant rows for this sub-sector						
Metropolitan Population	%					
Non-metropolitan Population	%					
Personal mobility	pkm/cap					
Energy Intensity	MJ/pkm					
Energy Use*	PJ					
Carbon intensity	tCO2/PJ					
Total emissions	MtCO2					
Total non-CO2 emissions (CH4 and N2O)	MtCO2e					

Metropolitan and non metropolitan population						
Metropolitan (*to be defined)	Millions inhab					
Non-metropolitan	Millions inhab					
Mobility and modal structure						
Constrained and non constrained mobility						
Passenger mobility	pkm/cap/year					
Yearly distance travelled by an average individual living in METROPOLITAN areas due to CONSTRAINED activities (work, school, shopping, administration...)	pkm/cap-Metrop/year					
Yearly distance travelled by an average individual living in METROPOLITAN areas due to NON CONSTRAINED activities (leisure activities)	pkm/cap-Metrop/year					
Non-metropolitan - Constrained (work, school, shopping, administration...)	pkm/cap-Non Metrop/year					
Non-metropolitan - Non-constrained (leisure activities)	pkm/cap-Non Metrop/year					
Modal distribution for Metropolitan - Constrained						
Private mobility	pkm/cap-Metrop/year					
Air	pkm/cap-Metrop/year					
Non-motorized transport	pkm/cap-Metrop/year					
Public transport	pkm/cap-Metrop/year					

Modal distribution for Metropolitan - Non-constrained						
Private mobility	pkm/cap-Metrop/year					
Air	pkm/cap-Metrop/year					
Non-motorized transport	pkm/cap-Metrop/year					
Public transport	pkm/cap-Metrop/year					
Modal distribution for Non-metropolitan - Constrained						
Private mobility	pkm/cap-Non Metrop/year					
Air	pkm/cap-Non Metrop/year					
Non-motorized transport	pkm/cap-Non Metrop/year					
Public transport	pkm/cap-Non Metrop/year					
Modal distribution for Non-metropolitan - Non-constrained						
Private mobility	pkm/cap-Non Metrop/year					
Air	pkm/cap-Non Metrop/year					
Non-motorized transport	pkm/cap-Non Metrop/year					
Public transport	pkm/cap-Non Metrop/year					
Indicators for constrained mobility						

Yearly time spent in transport due to constrained activities for an average individual living in Metropolitan areas (Time - Metrop)	% of 2010 - value					
Time - Non Metrop	% of 2010 - value					
Yearly Distance travelled by an average individual living in Metropolitan areas due to constrained activities (Distance - Metrop)	% of 2010 - value					
Distance - Non Metrop	% of 2010 - value					
Yearly Budget spent in transport due to constrained activities for an average individual living in Metropolitan areas (Budget - Metrop)	% of 2010 - value					
Budget - Non Metrop	% of 2010 - value					
Transport budget						
Budget dedicated to transport due to Constrained activities for an average individual living in Metropolitan areas (Budget M-Constrained)	% disposable income					
Budget M-Non-constrained	% disposable income					
Budget NM-Constrained	% disposable income					
Budget NM-Non-constrained	% disposable income					
Car stock						
Total car stock	Million (Mio) vehicle					
Car stock shares						
Liquid ICE (Internal Combustion Engine)	Mio vehicle					

Gas ICE (Internal Combustion Engine)	Mio vehicle					
BEV (Battery Electric Vehicle)	Mio vehicle					
PHEV (Plug-and-Hybrid Electric Vehicle)	Mio vehicle					
FCEV (Fuel-Cell Electric Vehicle)	Mio vehicle					
Emissions of new cars						
Average of new sales	gCO2/vkm					
Car sales						
Liquid ICE (Internal Combustion Engine)	Mio veh / year					
Gas ICE (Internal Combustion Engine)	Mio veh / year					
BEV (Battery Electric Vehicle)	Mio veh / year					
PHEV (Plug-and-Hybrid Electric Vehicle)	Mio veh / year					
FCEV (Fuel-Cell Electric Vehicle)	Mio veh / year					
Pillars of decarbonization						
Passenger mobility	pkm/cap/year					
Energy efficiency	MJ/pkm					
Carbon content of electricity	gCO2/kWh					
Average biofuel share in liquid fuel and pipe gas	%					
Non fossil fuel mobility (% of total EJ)	%					
Average carbon content of energy	gCO2/MJ					
Final energy consumption						
Total	EJ					
Liquid fossil	EJ					
Natural gas	EJ					
Electricity	EJ					
Hydrogen	EJ					
Liquid biofuels	EJ					
Biogas	EJ					
Renewable hydrogen	EJ					

Emission drivers						
Population (inhabitant)	% of 2010 - value					
Individual mobility (pkm/cap)	% of 2010 - value					
Mobility energy efficiency (MJ/pkm)	% of 2010 - value					
Carbon intensity (gCO2/MJ)	% of 2010 - value					
CO2 emissions						
Oil air	MtCO2					
Oil road	MtCO2					
Oil rail	MtCO2					
Natural gas	MtCO2					
Total direct CO2 emissions	MtCO2					
Biofuels (liquid or gas)	MtCO2					
Electricity	MtCO2					
H2 and biofuels	MtCO2					
Total indirect CO2 emissions	MtCO2					

3.4. The sectoral pathway description for the agriculture, forestry and land-use sector

STORYLINE	***Short term (i.e. next 1-5 years)***	***Medium term (2025-2030)***	***Long term (2030-2040)***
Macro-level elements			
*o **Urbanisation**: describe the evolution of urbanisation (e.g. the speed of urbanisation, the share of the population live on the countryside, etc)?* *o **National land tenure regimes**: a) how (if at all) does land tenure impact land use changes and land management? b) how (if at all) is land tenure changed to support the transformation of the AFOLU sector?*			
Agriculture production			
Crop production			
*o **How will methods with which agricultural crop output is produced evolve?** In your response, pay specific attention to the systems of production: are there shifts in the systems of agricultural production (e.g. organic and conventional systems), with regards to surface and output?* *o **Soil fertility**: how do the practices employed to ensure soil fertility change?* *o What drives changes regarding fertiliers in the scenario?*			
Animal production			

o ***Animal production methods***: *How will the practices used in livestock rearing evolve? In your response, pay specific attention to the systemos of production: are there shifts between intensive (typically feedlots or indoors with high concentration of animals per ha) and extensive (typically outside on prairies / grasslands) systems of livestock rearing?* o ***Animal feed***: *how do the sources of animal feed evolve? How (if at all) is animal feed used to reduce animal emissions?* o ***Animal productivity***: *what drives changes in animal productivity?* o *How does practices regarding animal manure evolve (both regarding manure left on pasture, manure used as fertiliser, and manure managed in other ways)?*			
The organisation of farms			
o ***Mixed farms***: *Will most farms be mixed, or will they concentrate on either crop or animal production? Mixed farms (or at least close geographical proximity between crop and animal production) allows the use of crop co-products in animal production and vice versa and hence reduces the demand for external inputs.*			
Socio-economic organisation of farms			
o ***Farm size***: *how does the size of farms evolve in terms of employment, financial turnover, and land? A general description of tendencies suffices.* o ***Agricultural labour***: *how does agricultural demand for labour and agricultural wages evolve? How does labour productivity evolve, and what underpins the changes?* o ***Capital intensity:*** *How much capital (ie buildings, machines, other technological aids) do farms have at their disposal for agricultural production? What is the access to finance for farmers?* o ***Drivers of change***: *what are the key drivers of the socio-economic transformation of agriculturae (urbanisation, greater demand for labour in higher paying sectors, etc)?*			

Forests and other sinks: how do forests and their role in the ecosystem and in the economy evolve?			
Forest (and peatland) protection and management			
*o **Forested surfaces/ deforestation**: what are the main drivers of deforestation (if any), and what type of forestlands are deforested?* *o **Forest protection**: What laws / regulation / other tools are employed to protect forests, if any? How effective is the protection?* *o **Land tenure**: How does the land tenure of forestland (and other land not intensively used by humans) evolve, and how (if at all) is land tenure linked to forest protection and land use change?*			
Forests (and peatland) as an economic resource			
*o **Forest production**: Are forests used as a productive resource? If so, for what purposes is wood harvested (energy, construction, firewood)?* *o What types of forests are valorised as economic resources (eg. primary forests / natural reserves)?*			
Carbon sink strategies			
o Do carbon sinks play an important role in national decarbonisation? What are the sinks (forests, peatlands, BECCS, etc.)?			
Demand: how is the produce of agriculture used and consumed?			
Food and diets			
*o **Drivers of dietary change**: what are the drivers of dietary changes? Eg changes GDP/capita, income per HH, etc. In your response, pay specific attention to dietary changes involving animal products.* *o **Inequalities of diets**: what inequalities of diets hides behind an average value of kcal/day (obesity, undernourishment). Is food available to the entire population (food security)?* *o **Food waste and losses**: what drives changes in food waste and losses?*			
Biomass for energy purposes			

o Which bio-material is valorised for energy purposes (wood, agricultural residues, animal waste)? o ***Bioenergy vs food security***: does the production of this biomass risk displacing other essential land uses, such as food production or forest land? If not, how is this risk averted? o Does bioenergy play an important role in the national energy supply and the national energy transition?			
National / international			
o ***AFOLU trading profile***: is the country generally an exporter or importer of products from the AFOLU sector (agricultural products, forest products, others)? Which products are exported and which products are imported? o ***Drivers of change***: what drives changes in the imports and exports of AFOLU products? In your response, pay specific attention to emissions intensive products like animal products and wood products.			
Biodiversity (new)			
o How does biodiveristy in agricultural landscapes evolve? - What are the impacts of agricultural crop production on biodiversity? Elements of interest include place of agroforestry or other agroecological structures (such as hedges) in agriculture; the share of agricultural land under monocultures; pesticide application (also in DB). - What are the impacts of agricultural animal production on biodiveristy? Elements of interest include the share of extensive livestock systems in livestock production; animal density on grazingland (also in DB) o How does biodiversity on natural lands evolve? Elements of interest are the character of forest plantations: do they consist of heavily exploited monocultures (eg palm oil), or a more diverse range of species?			

Transversal issues			
***Water**: What is the impact of the transformations on the replenishment of water supply and usage?*			
***Leadership**: Who are the actors that drive the change?*			

DASHBOARD		**Starting year**	**2020**	**2030**	**2040**	**2050**
Extract of the Economy-wide DB TAB relevant rows for this sub-sector						
Agriculture						
Sectoral GDP	Billion USD $2015					
Energy Intensity	PJ/Bn$					
Energy Use*	PJ					
Carbon intensity	tCO2/PJ					
Total CO2 energy-related emissions	MtCO2					
Total CO2 non-energy-related emissions	MtCO2					
Non-energy GHG emissions intensity	tCO2e/Bn$					
Total non-energy GHG emissions (N2O)	MtCO2e					
Total non-energy GHG emissions (CH4)	MtCO2e					
Total non-energy GHG emissions (CH4 and N2O)	MtCO2e					
Land use change						
Total CO2 LULUCF net emissions (forests)	MtCO2					
Total CO2 LULUCF net emissions (all other fluxes)	MtCO2					
Total CH4 Emissions	MtCO2e					
Total N2O Emissions	MtCO2e					

Aggregated indicators: primary pillars of decarbonisation						
Total agricultural production (incl. foodcrops and animal products)	Billion kcal / year					
Share of animal products in diet	% of kcal / day / person					
Intensity of production (total kcal produced / total agricultural surface)	Ha / kcal produced					
Average carbon efficency of production	tCO2eq / kcal produced					
Annual net change of surface under forestland and peatland (land uses that enable C significant sinks)	Ha					
Surface for growing agricultural and forest biomass for energy	Ha					
Emissions summary						
Land use change						
Total	MtCO2					
Sub-total Net forest change	MtCO2					
Sub-total Net non-forest change	MtCO2					
Emissions from forest losses (deforestation)	MtCO2					
Emissions from forest gains (a-/reforestation)	MtCO2					
Emissions from land remaining forestland (increase or decrease in C / ha)	MtCO2					
Net emissions from grasslands	MtCO2					
Net emissions from croplands (incl perennial crops)	MtCO2					
Emissions relating to peatlands (fires and degradation)	MtCO2					
Management practices						

Total	MtCO2eq					
Total CH4	MtCO2eq					
Total N2O	MtCO2eq					
Enteric fermentation (CH4)	MtCO2eq					
Manure management, incl manure left on pasture (N2O)	MtCO2eq					
Manure management (CH4)	MtCO2eq					
Synthetic fertilisers (N2O)	MtCO2eq					
Manure applied to soils (organic fertilisers) (N2O)	MtCO2eq					
Rice paddies (CH4)	MtCO2eq					
Liming of managed soils (CO2)*	MtCO2					
On-farm energy related emissions in agriculture (all gases)*	MtCO2eq					
Agricultural consumption						
Evolution of national diets						
Total calory intake	kcal / cap / day					
Dairy products	kcal / cap / day					
Ruminant meat	kcal / cap / day					
Other meat	kcal / cap / day					
Rice	kcal / cap / day					
Other cereals	kcal / cap / day					
Roots and tubers	kcal / cap / day					
Oilcrops	kcal / cap / day					
Sugarcrops	kcal / cap / day					
Legumes / pulses	kcal / cap / day					
Fruits and vegetables	kcal / cap / day					
Level of food waste and losses at national level						

Post harvest food losses: losses during storage, transport and retail	ton / year					
Food waste at final consumer	ton / year					
Evolution of trade - net flows						
Dairy products	1000 tons / year					
Ruminant meat	1000 tons / year					
Other meat	1000 tons / year					
Rice	1000 tons / year					
Other cereals	1000 tons / year					
Roots and tubers	1000 tons / year					
Oilcrops	1000 tons / year					
Sugarcrops	1000 tons / year					
Legumes / pulses	1000 tons / year					
Fruits and vegetables	1000 tons / year					
Wood products	MCUM / year					
Agricultural production						
Animal production						
Total animal production						
Total animal production, in kcal	Billion kcal / year					
Total animal production, in tons	Mtons / year					
Evolution of animal herds						
Cattle	Animal heads					
Sheep and goats	Animal heads					
Pigs	Animal heads					
Poultry	Animal heads					
Evolution of animal productivity						
Milk: cattle	Litres / cow / year					
Milk: goats and sheep	Litres / ewe / year					

Meat: cattle	Tons of carcass weight at slaughter / head					
Meat: goats and sheep	Tons of carcass weight at slaughter / head					
Meat: pigs	Tons of carcass weight at slaughter / head					
Meat: poultry	Tons of carcass weight at slaughter / head					
Animal density						
Share of cattle that spend more than 50% of their days on grazingland (ie on paddocks, prairies and grasslands - extensive grazing)	% of all cattle heads					
Grazing intensity	Heads of cattle / ha grazing land					
Animal density	Animal heads in LU / ha of agricultural land					
Animal feed						
Feed conversion ratio for cattle: milk	kg dry matter feed (cumulative over lifetime) / litres of milk produced (cumulative over lifetime)					
Feed conversion ratio for cattle: meat	kg dry matter feed (cumulative over lifetime) / kg					

	carcass weight at slaughter					
Crop production						
Total crop production						
Total crop production of common feedcrops (sugar cane, soybean, maize, oil palm, ?), in kcal	Billion kcal / year					
Total crop production of common feedcrops (sugar cane, soybean, maize, oil palm, ?), in tons	Mtons / year					
Crop yields						
Sugar cane (and other sugarcrops)	ton / ha / year					
Soybean	ton / ha / year					
Maize	ton / ha / year					
Rice	ton / ha / year					
Wheat	ton / ha / year					
Bananas	ton / ha / year					
Oil palm	ton / ha / year					
Coffee	ton / ha / year					
Cotton	ton / ha / year					
Cropping intensity (frequency of harvest)						
Cereals (including maize, rice and wheat)	N° of harvests / year / hectare					
Other foodcrops	N° of harvests / year / hectare					
N application						
Synthetic N application	tonnes / ha					
Organic N application	tonnes / ha					
Liming application	ton / ha / year					
Land use						

Cropland	Ha					
Grassland (permanent)	Ha					
of which, used for grazing	Ha					
of which, other grassland	Ha					
Forestland	Ha					
of which, natural forests	Ha					
of which, plantation forest	Ha					
Wetland	Ha					
Settled land	Ha					
Other land	Ha					
Biogenic sink and forestry						
Deforestation						
Loss of natural forest (definition in column I)	Ha / year					
Forest density and degradation						
Density of forests: forests plantations (definition in column I)	Ton C / ha (above and below ground biomass)					
Density of forests: natural forests	Ton C / ha (above and below ground biomass)					
Forest sequestration rate						
Sequestration rate: forests plantations (definition in column I)	Ton C / ha / year					
Sequestration rate: natural forests	Ton C / ha / year					
Forest production and withdrawals						
Timber harvested for economic or subsistence purposes	MCUM / year					
Non-timber forest products	MCUM / year					
Bioenergy production: Producing biomass for fossil CO2 substitution (bioenergy / biomaterial)						

Land use for energy production from agricultural and forest biomass	Ha					
Total bio-energy produced	MJ / year					
Energy produced from crops and forests (ie excl coproducts)	MJ / year					
Trade-offs or synergies with other sectors						
Biodiversity						
Pesticides	kg / ha of cropland					
Natural land (forests, wetlands, extensively managed grassland)	Ha					
Protected lands	Ha					
Food security						
Share of population in undernourishment	%					

References

Deep Decarbonization Pathways Project consortium (2015): Pathways to deep decarbonization 2015 report, SDSN - IDDRI.

Chris Bataille, Henri Waisman, Michel Colombier, et al. (2016): The Deep Decarbonization Pathways Project: Insights and Emerging Issues, Special issue 1, volume 16, Climate Policy.

The DDPP network (2016): 2050 low-emission pathways: domestic benefits and methodological insights – lessons from the DDPP, Issue Brief n°15/16, IDDRI.

Jim Williams, Henri Waisman (2017): 2050 Pathways: a handbook, 2050 Pathways Platform.

IPCC (2018): Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. World Meteorological Organization, Geneva, Switzerland, 32 pp.

Henri Waisman, Chris Bataille et al. (2019): A pathway design framework for national low greenhouse gas emission development strategies, Nature Climate Change.

IDB and DDPLAC consortium (2019). Getting to Net-Zero Emissions: Lessons from Latin America and the Caribbean. Inter-American Development Bank, Washington D.C

Julien Lefèvre, Yann Briand , Steve Pye , Jordi Tovilla , Francis Li , Ken Oshiro , Henri Waisman, Jean-Michel Cayla & Runsen Zhang (2020): A pathway design framework for sectoral deep decarbonization: the case of passenger transportation, Climate Policy.

DDPLAC Consortium, Edited by C.Bataille. (2020): Policy lessons from the Deep Decarbonization Pathways in Latin America and the Caribbean Project (DDPLAC), IDDRI.

Chris Bataille, Henri Waisman, Yann Briand, Johannes Svensson, Adrien Vogt-Schilb, et al. (2020), Deep Decarbonization Pathways in Latin America and the Caribbean (DDP-LAC) – An assessment of low-emission development strategies in six LAC countries, Special Issue, Volume 30, Energy Strategy Reviews

Annex 1.

Economy-wide storyline

Cross-cutting elements		
	Description of cross-cutting elements of NATIONAL narrative	
Economy-wide national trends (key development and other non-climate goals should be included), *such as:*		
Development, incl SDGs indicators		
National climate policy & commitments		
Demography *(population growth, demographic structure, urban/rural emplacement, etc)*		
Economy *(growth, labour productivity to allow growth, access to investment capital, etc)*		
Social Dimension *(household disposable income as % of GDP, household size, GINI index, etc)*		
Trade		
National Circumstances		
Description of drivers of change in … **… activity levels**	**… the intensity of (energy, material, land, water) inputs to meet activity levels**	**… the GHG content of (energy, material, land) inputs**
Related to NATIONAL Energy system		

Related to NATIONAL Urban and infrastructure system, with a focus on transport and building sectors		
Example: The fast urbanization development (+25% of new urbanized land over the period), economic development and household revenue growth (+20%) will increase the access to more activities and increase the mobility of people (+30%).	Example: The development of infrastructures like sidewalks, bike lanes, road dedicated to public transport and mass transit will enable to reduce the energy intensity of the mobility. The technological improvements and innovations (automation, lighter materials, aerodynamisn, electrification...) will contribute to reduce the average energy intensity. Finally, the place and the role of car in the passenger mobility will be transformed by the digital economy which brings carpooling, by the city governements which distribute more spaces for low-energy, low air polluting and low congestion modes, and organized the proximity in the daily human activities. All of this contribute to walk, bike and to use public transport to lower the energy intensity of mobility.	Example: The electrification of transport and the use of sustainable-produced biofuels for transport enable to reduce the carbon intensity of the final energy used in transport.
Related to NATIONAL Industrial system, with a focus on GHG-intensive sectors		
What industrial policy? What is assumed for the scenario?	Where relevant and/or available, please refer to considerations and implications of prohjected activity data for material flows and water efficiency.	

Related to NATIONAL Land and ecosystems		
	Where relevant and/or available, please refer to considerations and implications of prohjected activity data for material flows and water efficiency.	

Economy-wide dashboard		**Starting year**	**2020**	**2030**	**2040**	**2050**
Aggregate indicators						
Assumptions						
Population	Million					
Urban Population	%					
Rural Population	%					
Metropolitan Population	%					
Non-metropolitan Population	%					
Gross Domestic Product	Billion $ USD (2015)					
of which: share in agriculture & forestry	%					
of which: share in energy-intensive industry	%					
of which: share in rest of industry	%					
of which: share in services	%					
Emissions Results (aggregated results by type of gas, acc to IPCC Inventories Guidelines categories)						

Total CO2 Emissions	MtCO2					
of which: Energy	MtCO2					
of which: IPPU (Industrial Processes & Product Use) sector	MtCO2					
of which: AFOLU	MtCO2					
of which: Waste	MtCO2					
Total CO2 Emissions without LULUCF	MtCO2					
Cumulative all CO2 emissions from 2020	MtCO2					
Total CH4 Emissions (without Energy & IPPU)	MtCO2e					
of which: AFOLU	MtCO2e					
of which: Waste	MtCO2e					
Total N2O Emissions (without Energy & IPPU)	MtCO2e					
of which: AFOLU	MtCO2e					
of which: Waste	MtCO2e					
Total non-CO2 Emissions (N2O, CH4, HFC, PFC, SF6, mix) for Energy & IPPU	MtCO2e					
of which: Energy	MtCO2e					
of which: IPPU (Industrial Processes & Product Use)	MtCO2e					
Total non-CO2 GHG Emissions	MtCO2e					
Sector indicators						
Energy Use (all final sectors)						
Final Energy Consumption	EJ					
Energy Import	EJ					
Energy Export	EJ					
Final Electricity consumption	TWh					
Households						
Residential buildings						
Average Floor Surface	sqm/cap					
Energy Intensity	GJ/sqm					
Energy Use*	PJ					

Carbon intensity	tCO2/PJ					
Total emissions	MtCO2					
Total non-CO2 emissions (CH4 and N2O)	MtCO2e					
Passenger transport						
Personal mobility	pkm/cap					
Energy Intensity	MJ/pkm					
Energy Use*	PJ					
Carbon intensity	tCO2/PJ					
Total CO2 emissions	MtCO2					
Total non-CO2 emissions (CH4 and N2O)	MtCO2e					
Productive sectors (Firms)						
Services (inc. Commercial Buildings)						
Sectoral GDP	Billion USD $2015					
Energy Intensity	PJ/Bn$					
Energy Use*	PJ					
Carbon intensity	tCO2/PJ					
Total emissions	MtCO2					
Total non-CO2 emissions (CH4 and N2O)	MtCO2e					
Energy-intensive industries (EII)						
Sectoral GDP	Billion USD $2015					
Energy Intensity	PJ/Bn$					
Energy Use*	PJ					
Carbon intensity (combustion emissions)	tCO2/PJ					
Total CO2 energy-related emissions	MtCO2					
Process CO2 emission intensity	kgCO2/$					
Total CO2 process-related emissions	MtCO2					
Total CO2 emissions	MtCO2					
Non-CO2 Process emission intensity	kgCO2e/$					
Total non-CO2 process-related emissions	MtCO2e					
Total GHG emissions	MtCO2e					
Light Industry (rest of industry)						

Sectoral GDP	Billion USD $2015					
Energy Intensity	PJ/Bn$					
Energy Use*	PJ					
Carbon intensity	tCO2/PJ					
Total CO2 energy -related emissions	MtCO2					
Total CO2 process-related emissions	MtCO2					
Total CO2 emissions	MtCO2					
Total non-CO2 process-related emissions	MtCO2e					
Total GHG emissions	MtCO2e					
Freight transport						
Freight mobility	tkm/$ GDP (2015)					
Energy Intensity	PJ/tkm					
Energy Use*	PJ					
Carbon intensity	tCO2/PJ					
Total CO2 emissions	MtCO2					
Total non-CO2 emissions (CH4 and N2O)	MtCO2e					
Agriculture						
Sectoral GDP	Billion USD $2015					
Energy Intensity	PJ/Bn$					
Energy Use*	PJ					
Carbon intensity	tCO2/PJ					
Total CO2 energy-related emissions	MtCO2					
Total CO2 non-energy-related emissions	MtCO2					
Non-energy GHG emissions intensity	tCO2e/Bn$					
Total non-energy GHG emissions (N2O)	MtCO2e					
Total non-energy GHG emissions (CH4)	MtCO2e					
Total non-energy GHG emissions (**CO2**, CH4 and N2O)	MtCO2e					
Land use change						
Total CO2 LULUCF net emissions (forests)	MtCO2					

Total CO2 LULUCF net emissions (all other fluxes)	MtCO2					
Total CH4 Emissions	MtCO2e					
Total N2O Emissions	MtCO2e					
Energy Supply						
Energy consumption of energy-sector industries	PJ					
Total CO2 emissions of energy-sector (combustion)	MtCO2					
Total CO2 fugitive emissions in energy sector	MtCO2					
Total CH4 fugitive emissions in energy sector	MtCO2e					
Non-energy uses of fuels	PJ					
Power generation						
Electricity production	TWh					
Carbon intensity	gCO2eq/kWh					
Electricity emissions	MtCO2					
Coal mining						
Coal production	Million Tonnes					
Combustion CO2 intensity per tonne	tCO2/t					
Total combustion CO2 emissions	Mt CO2					
Fugitive CH4 intensity per tonne	tCO2e/t					
Total fugitive CH4 emissions	Mt CO2e					
Fossil Oil and Gas Extraction						
Oil & Gas production	EJ					
Combustion CO2 intensity of production	tCO2/EJ					
Total combustion CO2 emissions	MtCO2					
Fugitive CO2 intensity of production	tCO2/EJ					
Gas production well-head, venting, & fugitive CO2 emissions	MtCO2					
Fugitive CH4 intensity of production	tCO2e/EJ					

Gas production well-head, venting, & fugitive CH4 emissions	$MtCO_2e$					
Liquid Fuel Refining						
Fuel production in EJ	EJ					
Combustion CO_2 intensity of production	tCO_2/EJ					
Combustion emissions from refining	$MtCO_2$					
Fugitive CO_2 intensity of production	tCO_2/EJ					
Fugitive CO_2 emissions	$MtCO_2$					
Fugitive CH_4 intensity of production	tCO_2e/EJ					
Fugitive CH_4 emissions	$MtCO_2e$					
Bio or Synthetic Gas production						
Gas production	EJ					
Combustion CO_2 intensity of production	tCO_2/EJ					
Combustion emissions from production	$MtCO_2$					
Fugitive CO_2 intensity of production	tCO_2/EJ					
Fugitive CO_2 emissions	$MtCO_2$					
Fugitive CH_4 intensity of production	tCO_2e/EJ					
Fugitive CH_4 emissions	$MtCO_2e$					
Bio or Synthetic Liquids production						
Liquids production	EJ					
Combustion CO_2 intensity of production	tCO_2/EJ					
Combustion emissions from production	$MtCO_2$					
Fugitive CO_2 intensity of production	tCO_2/EJ					
Fugitive CO_2 emissions	$MtCO_2$					
Fugitive CH_4 intensity of production	tCO_2e/EJ					
Fugitive CH_4 emissions	$MtCO_2e$					
Charcoal and biochar production						
Fuel production	Million Tonnes					
Combustion CO_2 intensity of production	tCO_2/t					
Combustion emissions from production	$MtCO_2$					
Fugitive CO_2 intensity of production	tCO_2/t					

Fugitive CO2 emissions	MtCO2					
Fugitive CH4 intensity of production	tCO2e/t					
Fugitive CH4 emissions	MtCO2e					
Gasification transformation processes - coal to liquids and gas to liquids						
Fuel production	EJ					
Combustion CO2 intensity of production	tCO2/EJ					
Combustion emissions from production	MtCO2					
Fugitive CO2 intensity of production	tCO2/EJ					
Fugitive CO2 emissions	MtCO2					
Fugitive CH4 intensity of production	tCO2e/EJ					
Fugitive CH4 emissions	MtCO2e					
Feedstock production (non-energy uses of fuel)						
Coal	Million Tonnes					
Fossil methane	Nm3					
Biomass / biochar	Million Tonnes					
Waste						
Total waste emissions	MtCO2e					
of which: Waste methane emitted as methane	MtCO2e					
of which: Waste methane emitted as CO2 (combusted)	MtCO2					
of which: N2O emissions	MtCO2e					