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MASTER'S THESIS

CORPORATE CLIMATE CHANGE MITIGATION STRATEGY – REVIEW AND CASE STUDY WITH ACT-S

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The clock of climate change is ticking. Yet, paradoxically, instead of reducing its pace, we are still accelerating it, as if the satisfaction thus generated was worth more than the idea of keeping some of this precious time left to future generations. Seeing their tomorrow being jeopardised, new generations are starting to act: it is time to reverse the trend.

Abstract

The climate, both at regional and global scales, is being disturbed, because of anthropogenic greenhouse gases emissions. Therefore, scientists and governments have been calling for important and quick cuts of these emissions, resulting in Paris Agreement on climate change. Individuals alone changing their behaviours and consumptions of resources would not be enough: companies also need to take action to limit their climate impact. As emissions were still increasing, the Carbon Disclosure Project (CDP) And the French Environment and Energy Management Agency (ADEME) launched ACT step-by-step (ACT-S): a method – based on the Science Based Targets initiative (SBTi) – which would help companies build their own transition plans from zero, *step by step*.

This method being quite recent, very little information or reviews were available about it in the scientific literature. Hence, the objectives of this thesis were to first define climate change mitigation strategies (CCMS), and then to understand the characteristics of a qualitative corporate CCMS, and if ACT-S is indeed suited to efficiently help companies elaborate effective ones. A literature review allowed to give a definition of CCMSs, identify similar or complementary initiatives and draw a list of criteria for their composition. The latter was then used to evaluate ACT-S both with a theoretical analysis of its methodology and with two concrete case studies.

This thesis showed that this method, while quite thorough and adapted for CCMS elaboration, bears some limitations preventing an optimal strive from companies against climate change. Some aspects of the methodology need to be detailed or modified to ensure both performance, convenience, reliability and transparency.

Keywords:

climate change, mitigation, corporate strategy, definition, ACT-S, Assessing low Carbon Transition

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Glossary

ADEME = Agence De l'Environnement et de la Maîtrise de l'Énergie (French Environment and Energy Management Agency)
BAU = Business-As-Usual scenario
IEA = International Energy Agency
CCMS = Climate Change Mitigation Strategy
CCMS = Climate Change Mitigation Target
CDP = Carbon Disclosure Project
CSR = Corporate Social Responsibility
DG = Degrowth scenario
ETP = Energy and Technology Perspectives (from the IEA)
EUCRA = European Union's Climate Risks Assessment
FTE = Full-Time Employee
GDP = Gross Domestic Product
GHG = GreenHouse Gas
LTCS = Long-Term Climate Strategy
NG = No growth scenario
NZI = Net Zero Initiative
IPCC = International Panel on Climate Change
SBT(i) = Science-Based Targets (initiative)
SDA = Sectoral Decarbonisation Approach
SWOT = Strengths, Weaknesses, Opportunities, and Threats
UN = United Nations
UNDP = United Nations Development Programme
UN Habitat = United Nations Human Settlements Programme
Urban LEDS = Urban Low Emission Development Strategies
WB2DS = (IEA's) Way Below 2 Degrees Scenario
WRI = World Resources Institute
WWF = World Wildlife Fund
2DS = (IEA's) 2 Degrees Scenario
6DS = (IEA's) 6 Degrees Scenario: a business-as-usual scenario

Introduction

Since the nineteenth century and the industrial revolution, humans started to use fossil fuels such as coal, oil and gas to run engines. This allowed fast and important progress in terms of technology, health and quality of life, but it has been discovered that burning such fossil fuels was releasing carbon – under the form of carbon dioxide – that had been trapped in the ground for millennia. Later, scientists found that this gas was contributing to an enhancement of the greenhouse effect (Arrhenius, 1896), at that, at a large scale, their emission into the atmosphere was causing great disturbance to the Earth's climate (Keeling, 1961; Broecker, 1975). Governments therefore decided to create an International Panel on Climate Change (IPCC) in 1988, which aim would be to gather and study the scientific literature on this topic, to provide clear overview of this problem and potential solutions. They showed that the cumulative total anthropogenic GHG emissions since 1870 was roughly proportional to the average surface temperature increase on the same period, as compared to pre-industrial period averages (IPCC WG I, 2013). This indicator is nowadays commonly called global warming level and is one of the main indicators for the observation and projections on global climate change (NOAA, 2023). They also evaluated that climate change was most certainly due to human activities (IPCC WG I, 2013). Hence, they concluded that anthropogenic CO_2 emissions, along with other greenhouse gases that had been identified, had to be cut in order to preserve the climate. They issued scenarios depicting different levels of concentrations of GHGs in the atmosphere and their associated estimation of global warming levels (IPCC WG I, 2013). For each of these scenarios, called Representative Concentration Pathways, a remaining global carbon budget was associated, representing the quantity of GHGs left to emit at a global scale to stay within the pathway's boundaries by 2100. Following their work and recommendations, governments gathered in 2015 to decide of a common objective between hundreds of countries: reduce their greenhouse gases emissions to limit global warming to 2 Celsius degrees above the average temperatures in the pre-industrial period (1880-1900) and move toward a 1.5 degrees goal. This objective was written in the Paris Agreement on climate. This target, among other GHGs, would mean to limit worldwide CO_2 emissions from 2020 to 2100 to 1,150 $GtCO_2$[1] (IPCC WG I, 2021), that is to say that humans would need to drastically decrease their emissions of greenhouse gases to lower the pace of these changes (IPCC WG III, 2014).

If individuals have an important role to play in this transition towards a more sustainable society, with the reduction of their carbon footprints, they do not have a control over all their emissions, and today's offer in terms of products and services does not allow them to reach the targets deemed to correspond to a "sustainable" – in terms of climate – way of living. Therefore, there is also a need for changes from authorities (may they be local, national, or global), but also from companies, producing the goods bought by citizens. Indeed, for example, in 2019 the consulting company Carbone 4 published a report entitled *"Doing your fair share?"*, in which they calculated that in France collective action would account for about ¾ of the overall action to reduce GHG emissions at national scale (Dugast et al., 2019).

We understand that companies have a major role to play in the transition toward a low carbon society, but we now need to comprehend how can they play this role: how can they reduce their GHG emissions? Is there a roadmap to follow for every company, helping them to set and reach targets? Starting from the observation that companies, even when they had set emission reduction targets, were still emitting more and more GHGs each year (SBTi, 2015), the CDP decided to develop a methodology to help companies to build a solid climate change mitigation strategy (CCMS). The Science-Based Targets initiative (SBTi) was therefore created to provide advice and quantified objectives to companies, which would be

[1] In its AR5, the IPCC had estimated this budget with a 66% confidence interval to be of 1,010 $GtCO_2e$ between 2011 and 2100 (Pachauri et al., 2015). It had been slightly under evaluated.

compatible with a 2 degrees scenario, by analysing recommendations made by scientists. After the publication of the Sectoral Decarbonisation Approach, the CDP and the French Environment and Energy Management Agency (ADEME) co-created, as part of the UNFCCC Agenda, Assessing Low carbon Transition step-by-step (ACT-S), a method based on this report and more broadly on the SBTi, providing a framework and tools for companies to concretely elaborate their transition plans. Given that very little review on this method had been published due to its recent release, evaluating its performance as a guidance for the establishment of corporate climate change mitigation strategies would be useful to understand it better. I tried to assess, through this paper, the pertinence of ACT-S to elaborate corporate climate change mitigation strategies, by comprehending the elements composing an efficient CCMSs and comparing them – both in theory and in practice – with the characteristics of the strategies built thanks to ACT-S.

Therefore, this thesis aims at answering the following questions:

- Does this method cover all the relevant elements of a good climate change mitigation strategy?
- Are the results generated with this method pertinent in the fight against climate change? Are the targets coherent with the different recommendations made by public organisations (such as the IPCC, the IEA, …)?
- What are the strengths and weaknesses of this method? What gaps can be identified?
- What kind of improvements could be brought to this method in the future?

I first set the scope of the study, by defining the terms that I would use along this thesis. Then, I studied the different methods and initiatives related to the definition of corporate climate change mitigation strategies. A particular attention was drawn to the ACT step-by-step methodology, which aim corresponds to the one we are seeking. I then composed with both this method and others previously studied to propose a single comprehensive method grouping all the steps necessary to the elaboration, implementation, and monitoring of a corporate CCMS. Furthermore, I provided a critical review of the ACT step-by-step methodology and its elements in two steps: after studying the origin of the different methodology elements (assumptions, origin and recommendations), I carried out two case studies with this method in order to evaluate its pertinence in the elaboration of climate change mitigation strategies. For the case studies, a particular attention has been given to CCMT setting, as I deemed this step to be of paramount importance and as the data I had was best first for this task.

With this thesis, I have shown that ACT-S was indeed efficiently helping companies for the elaboration of their CCMSs, with satisfying results in terms of climate change mitigation targets (CCMT) and action plans. However, the method can be used along with other initiative to reinforce its performance and the quality of the CCMS still depends on the company's ambition to actively tackle climate change. Additionally, if this method and its technical elements are indeed coherent with scientific recommendations and 2-degree trajectories, some of its aspects could still be improved in the future to facilitate the establishment of corporate CCMSs and increase their efficiency.

1. Corporate Climate change mitigation strategies

1.1. Definition

After carrying out a literature review on climate strategies and their elaboration, I noticed that none of the papers I went through provide a clear definition of what a climate strategy is. To this extent Zong underlined a lack of comprehensive framework for the establishment of a low carbon strategies (Zong et al., 2020). I then decided to look if there were official definitions, frameworks or even standards related to this topic, and a satisfying definition was still to be found. Therefore, in this part, we will aim at giving such definition, before going into further details about its components and the different methods to elaborate it.

1.1.1. Terminology

First, some could argue that the term "climate strategy" is too broad and does not give a clear overview of what is at stake. Indeed, when referring to "climate" (in "climate strategy" for example), what is usually meant is the sub-category of environment – and more specifically environmental protection – related to the emissions of GHG, linked to the "climate change" planet boundary (Rockström et al., 2014).

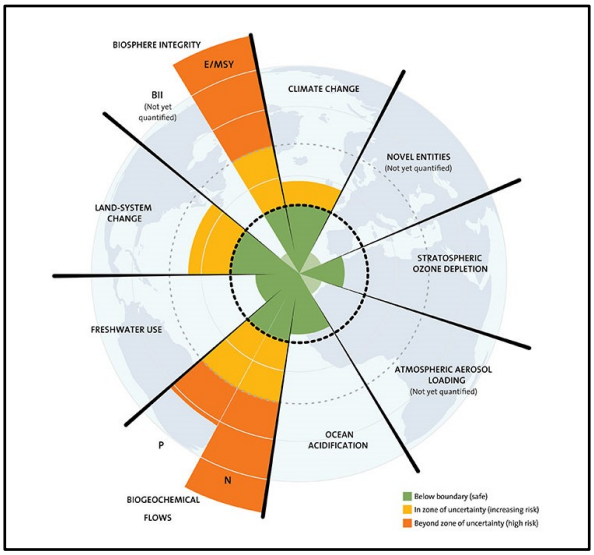

Figure 1.1a. Planet boundaries and quantified levels (Rockström et al., 2014)

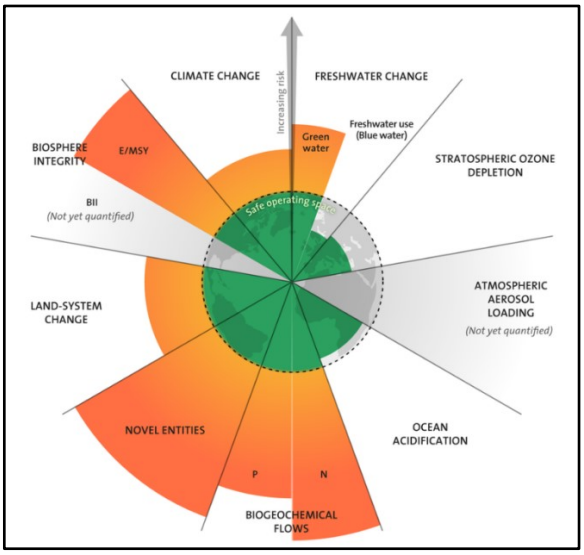

Figure 1.1b. Updated planet boundaries and currently quantified levels (BonPote, 2023; Wang-Erlandsson et al., 2022, Persson et al., 2022)

To that end, a more correct terminology would be "climate change strategy". Then, we can still debate that these terms could refer to various ideas: are we dealing with the causes of climate change? Its consequences? To overcome this lack of precision, we need to make a distinction between these two sub-topics within climate change. The first one, concerning the causes of climate change, is characterised by the term "mitigation", and the second one, related to the consequences is referred to as "adaptation" or "resilience". Obviously, here we are only talking about the attenuation of negative effects on humans and biodiversity, thus the absence of terms like "accentuation". This distinction is made by the TCFD:

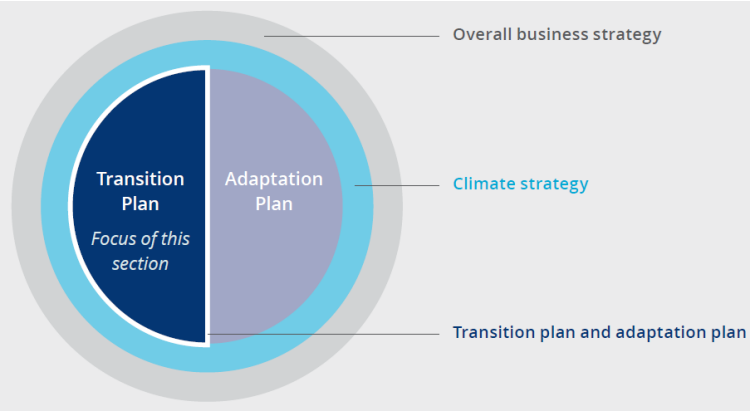

Figure 1.2. Representation of CCMSs as part of the business's strategy (TCFD, 2021)

Here, the "transition plan" refers to the mitigation of climate change[2].

This thesis will mainly deal with corporate climate change mitigation strategies (CCMSs), as it is the main focus of the ACT-S methodology that I studied, but the corporate climate change adaptation topic will still be discussed. In the thesis, I will use the terms "corporate", "company" and "organisation" interchangeably, and I will refer to corporate climate change strategy as CCMS.

1.1.2. Definitions

After having specified the terminology that is going to be used in the rest of the thesis, we now need to propose a definition of a climate change mitigation strategy. To do so, we will first define each term separately for a better understanding of the overall concept of a CCMS.

In the literature, various definitions of climate and climate change can be found. From a simple point of view, the NASA gives the following definition of climate: *"climate is the description of the long-term pattern of weather in a particular area"* (NASA, 2004). From this definition, we note that a distinction must be made between local climate, relative to a specific area, like a region or country, and Earth's (or global) climate, which corresponds to an aggregation of all the different climates around the world (NASA, 2014). Completing this definition, from a statistical perspective, Charlotte Werndl defines climate as a *"finite distribution over time that arises under the regime of varying external conditions"* (Werndl C., 2016). From Werndl's definition, the one of climate change can be derived as a situation where *"there are different climates for two successive time periods"* (Werndl C., 2016). Here, the author distinguishes *external* and *internal* climate changes, respectively being changes related to external conditions (due to sun activity, meteors, …) and changes related to internal conditions (anthropogenic GHG emissions, volcanic activity, …).

Another definition of climate is given by Kant et al., who describe it as *"a sub-set of environment"* (Kant et al., 2020), along with the following definition of climate change: *"a statistically significant variability in the climate's mean state persisting for a decade or longer periods, caused by the anthropogenic greenhouse gases (GHGs) emission, including excessive business operations"* (Kant et al., 2020) – "responsible for the erosion in the natural climate and resources" (Gladwin et al., 1995). Following the same idea, UK's Climate Change Committee defines climate change as the divergence of

[2] *NB:* Note here that only the term "climate" is mentioned, not "climate change"

current and future Earth's climate from the "normal" (average) situation observed in the past, bearing several impacts such as the warming of the troposphere, the acidification of the oceans, the rising of sea levels, the decline of glaciers and sea ice, and the slowing of increase to crop productivity (Climate Change Committee, n.d.).

In its Work Group I's 5th Assessment Report, the IPCC gives a more comprehensive definition of the climate change, by describing abrupt climate change as a *"large-scale change in the climate system that takes place over a few decades or less, persists (or is anticipated to persist) for at least a few decades and causes substantial disruptions in human and natural systems"* (IPCC, 2013).

Finally, in their Framework Convention on Climate Change, the United Nations define climate change as *"a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*" (United Nations, 1992). In reality, through this definition, the UNFCCC gives a definition of anthropogenic climate change rather than of climate change itself, as the climate change issue that is currently challenging the society is from the one from anthropogenic nature (Powell, 2017; IPCC WG I, 2021; BonPote, 2021). In the rest of this thesis, when talking about climate change mitigation, we will refer to the mitigation of anthropogenic climate change.

After giving this overview of how climate and climate change can be defined, we will now investigate the term "mitigation". The Oxford Dictionary of English tells us it is *"a reduction in how unpleasant, serious, etc. something is"* (ODE, 2022), that we can interpretate in our case as the minimisation of inevitable long-term changes in the Earth's climate. The term "inevitable" previously used has to be carefully explained here. Indeed, it does not state that the augmentation of the temperatures is locked in and cannot be avoided, as on the contrary zero GHG emissions levels would lead to a stabilisation of global mean temperatures (NASA, n.d.; Hausfather, 2021), but as a sudden stop of all GHG emissions is very unlikely, therefore leading to an inevitable temperature rise in the next years. Furthermore, within our study scope, the European Environment Agency provides the following definition: *"Mitigating climate change means reducing the flow of heat-trapping greenhouse gases into the atmosphere"* (European Environment Agency, 2023). In the WGIII's part of the IPCC's 5th Assessment report, the latter depicts *"[m]itigation, in the context of climate change, [as] a human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs)"* (IPCC, 2014), therefore clearly stating the human responsibility in the addressing of the climate change issue. Here we find again the idea of focusing solely on anthropogenic climate change.

As far as strategy is concerned, it can be defined as *"a combination of means and ends for achieving goals conceptualized on the basis of the relationship of corporate and their environment"* (Porter, 1980) "as a human attempt to ensure a better shaped future despite resource scarcity in the real world" (McKeown, 2012), in the context of environment.

The CDP uses a different terminology – "climate transition plan" –, which they define as *"a time-bound action plan that clearly outlines how an organization will pivot its existing assets, operations, and entire business model towards a trajectory that aligns with the latest and most ambitious climate science recommendations. i.e., halving greenhouse gas (GHG) emissions by 2030 and reaching net-zero by 2050 at the latest, thereby limiting global warming to 1.5°C"* (CDP, n.d.-a). With this definition, the CDP already starts to integrate criteria on the performance of these plans, which we did not consider in our scope. Additionally, this definition only focuses on corporate CCMSs, while the one I want to propose is wider, also including individuals and public entities.

By combining the previous definitions and research, we can propose our own definition of what is a climate change mitigation strategy[3]. Through the latter, I tried to fill the gaps highlighted before. This new definition is given in the Box B1:

A climate change mitigation strategy can be defined as:

"a set of means and ends an organisation or entity makes use of over time to achieve goals that are intended to contain the long-term anthropogenic climate change – as a planet boundary –, principally through minimising sources of greenhouse gases and enhancing their sinks."

Box B1. New definition of climate change mitigation strategies.

With this definition, we understand that a CCMS must consist in a set of targets aiming at addressing the long-term climate change, along with concrete measures to reach them over time. The following TCFD's definition clarifies what it specifically entails: "A climate-related target refers to a specific level, threshold, quantity, or qualitative goal that the organization wishes to meet over a defined time horizon in order to address its climate-related risks and opportunities." (TCFD, 2021). We understand here that a CCMS must contain quantified GHG emission level objectives, that result from calculations based on the organisation's climate-related risks and opportunities assessment. In the following part, we will discuss about the elements constituting a good CCMS, and the scopes associated with this topic.

1.1.3. Scopes and key elements of a CCMSs

In order to better analyse the ACT-S methodology, I first needed to understand if there are mandatory criteria a CCMS should respect. Are there specific scopes or key elements? Are there standards or other internationally recognised initiatives providing recommendations regarding these strategies, from their establishment to their implementation and monitoring? To answer these questions, I looked through the literature and tried to list and put in perspective all the elements that I found.

First, what struck me was the fact that most of the initiatives and recommendations related to CCMSs that can be found only concern CCMTs: the quantified goals of corporate climate change mitigation are well known. To this extent, the US Environmental Protection Agency (EPA) provided several criteria concerning quality climate change mitigation targets (EPA, 2022). According to this organisation, a CCMS should include both a base and a target year, and the time period between the two should be between 5 and 10 years. Then, the targets should:

- Be aggressive, which means be way more ambitious than the business-as-usual trajectories and be ambitious enough in relation to absolute goals.
- Deal with an absolute reduction of GHG emissions.
- Cover emissions generated all over the world, not only in the concerned country.
- Address all three emission scopes (at least partially for scope 3 emissions).
- When declared publicly, include all the information mentioned above.

While these points constitute the pillars of what is considered to be a "good CCMS", they remain quite vague, so one could identify the need for more precise recommendations or even a standard, to have comparable methods between companies. To this extent, in his paper on the ways to address climate

[3] I voluntarily chose to propose a wider definition than corporate CCMS, also adapted to public entities' CCMSs.

change, Zong pinpoints the lack of comprehensive framework for the establishment of a low carbon strategy and proposes a list of considerations within this scope (Zong et al., 2020).

To this date, there is only one existing standard concerning the climate change strategies: the Corporate Net-Zero Standard, by the Science Based Target initiative (SBTi, 2023). It consists in a framework in accordance with IPCC's and IEA's reports for corporate net-zero target setting. This goes down to a framework for the establishment of organisational climate change mitigation strategies. This standard is based on four main key elements, which are as follows:

- Prioritisation of rapid, deep emission reductions by setting near-term targets: *-50% GHG emissions (at least) by 2030 as compared to 2020 levels.*
- Setting of long-term targets: *-90% GHG emissions (at least) by 2050 as compared to 2020 levels.*
- Neutralisation of residual emissions: *compensation of the <10% left using permanent carbon removal techniques.*
- Climate finance beyond the value chain: *investment on companies and technologies aimed at contributing to the previous points, in addition to emission cuts and compensation.*

As far as scopes and boundaries are concerned, this standard states that near-term targets should concern at least 95% of the organisation's scope 1 and 2 emissions and 67% of scope 3 emissions if this category represents more than 40% of the organisation's overall emissions. For long-term targets, the standard still mentions a minimum of 95% of scope 1 and 2 emissions but sets a minimum of 90% of scope 3 emissions that should fall within the scope of climate mitigation targets.

This standard provides further detail regarding the goals' part of CCMS. It specifically presents some values in relation to time and GHG quantities. Yet, if this standard gives a framework for target setting, which is part of a climate change mitigation strategy, it does not give a complete scope on the latter. Indeed, such standard lacks elements such as a list of consecutive steps to follow in order to establish a complete and pertinent climate strategy, a list of mandatory key elements that such strategy should contain or even. Hence, we will try to give a comprehensive overview of the key elements a CCMS should bear, beyond the CCMTs. To this extent, Achala Abeysinghe, researcher at the International Institute for Environment and Development (IIED), listed seven points that a good Long-Term Climate Strategy (LTCS) should display (Abeysinghe, n.d.). According to her, such strategies should verify the following criteria, numbered from 1 to 7:

- C1. Address long-term vision and mention actionable policy options, that is give concrete solutions to reduce GHG emissions, generally with a 2050-time horizon.
- C2*. Involve senior political figures in its development process, who have an overview on the feasibility of some actions and previous experience in elaboration of strategy.
- C3. Allocate responsibilities (in terms of emissions and action) between the different stakeholders.
- C4. Be coordinated by an overseeing institutional authority.
- C5. Designate a leader of technical work and operationalisation of the LTCS.
- C6*. Involve all the relevant ministries of the country under study, to avoid competing or overriding policies.
- C7*. Be inclusive and transparent to the public, by involving citizens in the discussion processes and by assessing the impacts of potential measures on other aspects of the society.

As we can see throughout criteria C2*, C6* and C7*, Abeysinghe here mostly deals with national level LTCS, therefore implying ministries and politics in the establishment process. Nevertheless, these criteria can easily be adapted for corporate CCMS: by analogy, ministries can be assimilated to sections or departments of a company, and ministers or senior political figures can be embodied by department managers and executive officers. Following this logic, criteria C2*, C6* and C7* can be rephrased, in our case, as follows:

- C2. Involve company's managers and executives in its development process, who have an overview on the feasibility of some actions and previous experience in elaboration of strategy.
- C6. Involve all the relevant departments of the company under study, to avoid competing or overriding policies.
- C7. Be inclusive and transparent to the public, by involving citizens, suppliers and clients in the discussion processes and by assessing the impacts of potential measures on other aspects of the society and/or businesses.

This set of seven criteria will be used as a comparative basis for the review of the ACT-S methodology:

C1. *Address long-term vision and mention actionable policy options, that is give concrete solutions to reduce GHG emissions, generally with a 2050-time horizon.*

C2. *Involve company's managers and executives in its development process, who have an overview on the feasibility of some actions and previous experience in elaboration of strategy.*

C3. *Allocate responsibilities (in terms of emissions and action) between the different stakeholders.*

C4. *Be coordinated by an overseeing institutional authority.*

C5. *Designate a leader of technical work and operationalisation of the LTCS.*

C6. *Involve all the relevant departments of the company under study, to avoid competing or overriding policies.*

C7. *Be inclusive and transparent to the public, by involving citizens, suppliers and clients in the discussion processes and by assessing the impacts of potential measures on other aspects of the society and/or businesses.*

Box B2. Abeysinghe's criteria regarding good CCMSs.

Following Zong's article, to determine a climate change mitigation strategy, private or public organisations first need to break down the national climate change targets into local objectives, and more precisely at industry level, along with relevant carbon emission indicators for the industry concerned (Zong et al., 2020). Moreover, they need to use the local climate target(s) to define their emission reduction strategy. Then, for each corporate climate change mitigation measure, the organisation needs to disclose the estimated associated GHG emission reduction and to calculate the cost benefits associated. Finally, the implementation of the corporate climate change mitigation strategy has to be regularly monitored, to evaluate its efficiency and the effectiveness of its implementation by the organisation.

1.2. Useful methodologies and frameworks

The goal of this thesis being to discuss the pertinence of ACT-S methodology in the determination of corporate CCMSs, I will compare this tool with other climate change mitigation initiatives or useful methodologies and frameworks I deemed to be useful to set a CCMS. This analysis will allow us to determine whether these methods and initiatives can or should be complementary in the establishment of CCMSs.

To do so, I investigated the scientific literature on this topic. The purpose of this step was to provide an overview on existing initiatives or methods aiming at setting climate mitigation targets and at elaborating low carbon strategies, in order to compare their characteristics to the one of ACT initiative. To avoid having a too broad scope of study, I decided to limit my research to climate change mitigation. Therefore, other initiatives dealing with complementary aspects such as climate resilience and adaptation or finance were analysed in order to understand the mechanics behind them and to study their possible addition to the ACT step-by-step methodology[4], but will not be mentioned hereafter.

For each method/initiative found, I ask myself what points these methods had in common with ACT. Therefore, the goal was to identify the answers to the following questions:

- Do these methods have the same object of study?
- Do they deal with the same scopes?
- Do they all rely on science or are they based on other criteria?
- How efficient are they compared to each other?
- What are their strengths? Gaps?
- (How) can the method/initiative complete ACT-S?

To dig in the current literature, I used my personal knowledge and the Climate Initiatives Platform to look for similar methods. I only focused my research on the methods and initiatives that would be valid at an international level because the final purpose of this study is to propose a methodology that could be used by companies all over the world. Then, I selected the most commonly used, more developed ones and the ones I deemed to be promising because of their complementarity with ACT-S. The selection I have made also reflects several aspects of good practices for several fields and scopes: organisational CCMT and CCMS (SBTi & NZI), financial and disclosure frameworks (TCFD), public entities and territories' transition plans (Urban LEDS), and risk assessment (EUCRA & SWOT).

1.2.1. Science Based Target initiative (SBTi)

The Science Based Target initiative is a collaborative effort led by several international organisations such as the CDP, the United Nations, the WRI (World Resources Institute) or the WWF (World Wildlife Fund), launched in 2015. This programme is based on two fundamental beliefs:

- "There is really no other credible target than one informed by science" (SBTi, 2015).
- "A global carbon budget must be distributed not only amongst countries, but also among sectors" (SBTi, 2015).

By offering a framework for setting and attaining *science-based* GHG reduction targets, the program seeks to advance corporate sustainability and combat climate change. The Science-Based Targets Initiative understands that for emissions reduction targets to be effective in addressing climate change,

[4] See parts 2.3 and 2.5 of this report.

they must be supported by scientific evidence and coordinated with the objectives of the 2015 Paris Agreement. The latter intends to keep global warming well below 2°C over pre-industrial levels, and aims for a more ambitious goal of +1.5°C.

To do so, in May 2015, the initiative published the Sectoral Decarbonisation Approach (SDA), presenting a clear and transparent methodology for companies to set their GHG emissions reduction targets according to their sector of activity, with emission levels, indicators, and metrics they should use. The idea behind the SDA is that the global remaining carbon budget should be distributed among sectors. The numbers in this document, depicting the target emission levels, come from the 2014 2DS scenario of the Energy and technology perspectives report, published by the International Energy Agency (IEA), where the IEA takes into account, for each sector, several factors like present emission levels and anticipated growth to estimate the necessary degree of emissions reductions. The 2DS scenario has been built to be consistent with the RCP2.6 pathway, therefore compatible with a sub-2-degree global warming. Hence, it appears interesting for our objective of building sub-2-degree aligned CCMSs. Then, for each sector, the IEA provides emissions reduction goals, under the form of absolute and relative emissions reductions, with overall emissions or with emission intensity indicators (e.g., CO_2 emission levels per ton of steel produced for steel industries, tCO_2 per monetary unit, …). After presenting the sectoral goals in terms of GHG emissions reductions, the IEA also provides suggestions of concrete actions and measures that companies can take in order to achieve these objectives.

The SDA rely on a set of key assumptions, mostly inherited by the modelling parameters of the IEA's 2DS:

A1. *The carbon intensity of each company in a homogeneous sector will converge with the sectoral carbon intensity in 2050.*

A2. *The SDA method intrinsically accounts for regional differences regarding level of activity and carbon intensity, but not explicitly in relation to geographical resources or historical responsibility.*

A3. *Economic growth is decoupled from CO2 emissions arising from the use of energy and materials.*

A4. *Value-added is defined as gross profit, which equals revenue minus cost of purchased goods and services.*

A5. *Scope 2 emissions from heat, steam, and cooling are assumed to be negligible compared to those of electricity; this also holds for the longer term.*

A6. *The societal goal to stay below 2°C is sufficient to avoid dangerous climate change and thus the consequent carbon budgets to stay below that threshold are used.*

A7. *The method is built on a CO2 budget that considers non-CO2 radiative forcings.*

A8. *If companies adopt long-term targets (e.g., in 2050) they are also taking on short-term targets along the non-linear RCP2.6 trajectory that ensures the overall budget is not blown.*

Box B3. Key assumptions of the SDA (SBTi, 2015).

The SDA only deals with CO_2 emissions when it comes to current emissions, projections, and recommendations for target setting. Therefore, we can note that all results will be expressed in tCO_2 (and not tCO_2e). This choice was made to simplify the calculations and statements. However, the SBTi recommends and expects reductions for the emission of other GHGs with a similar fashion to the one of CO_2, and non-CO_2 radiative forcings have been considered in the calculations. While this may be accurate and/or adapted to some sectors where other GHGs does not have an important weight in the overall GHG emissions, such as the construction sector for example, this hypothesis seems to be less pertinent when it comes to sectors for which emissions of other GHGs are important, such as the agriculture and agrifood sector (which has important emissions of CH_4 and N_2O).

Several examples of sub-sectoral scenarios are presented below, for the industry sector:

$MtCO_2$	2011	2050	
		6DS	2DS
Iron and steel	2 991	3 677	2 044
Chemicals and petrochemicals	1 273	3 720	1 988
Cement	2 163	2 605	1 692
Pulp and paper	237	345	164
Aluminium	150	375	333

Table 1.1. Sector-specific yearly direct CO_2 emissions by scenario[5], for industries (IEA, 2014)

On this table we can see a comparison of current direct CO_2 emissions with two different scenarios. While the 6DS scenario is interesting to understand what emissions would look like in 2050 if no particular measures are taken to address the long-term global climate change issue, we will only focus on the 2DS scenario, representing the core of our study. From these levels can be derived the emission intensities, thanks to an analysis of the prospects in the sectoral activity. For homogenous sectors[6], the +2°C compatible carbon intensity of a sector is calculated with the following formula, for homogenous sectors:

$$+2°C\ compatible\ carbon\ intensity\ of\ sector\ S, year\ Y = \frac{total\ direct\ emissions\ in\ year\ Y}{activity\ index\ of\ sector\ S\ in\ year\ Y}$$

Here, the "activity index" corresponds to the index (an indicator with a value of 100 for the base year) calculated using physical activity indicators (for example tons of aluminium sold per year).

More precisely, for scope 1 emissions, the carbon intensity is calculated as follows:

$$CI_y = d \times p_y \times m_y + SI_{2050}$$

with $d = CI_b - SI_{2050}$

$p_y = \frac{SI_y - SI_{2050}}{SI_b - SI_{2050}}$

$m_y = \frac{CA_b/SA_b}{CA_y/SA_y}$

d: initial company performance in base year b (as compared to 2050)

p_y: decarbonisation index of the sector in year y

[5] The 6DS scenario corresponds to a *business-as-usual* scenario, leading to +6°C global warming levels in 2100.
[6] Sectors within which companies are producing comparable and quantifiable products or services.

m_y: market share parameter in year y
CI_y: company's carbon intensity in year y
SI_y: sector's carbon intensity in year y
CA_y: company's activity level in year y
SA_y: sector's activity level in year y

This way of calculating objectives result in a convergence of carbon intensities of all companies from the same sector in 2050:

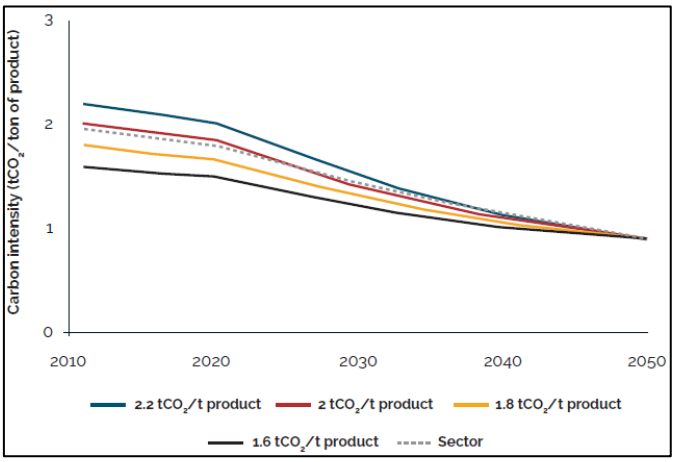

Figure 1.3. Convergence of carbon intensities and effect of initial performances on the pathways (SBTi, 2015)

For heterogenous sectors[7], we often cannot calculate the carbon intensity this way. Therefore, the SBTi chose to use a method called "compression of carbon intensity". The latter considers equal reductions between companies in terms of absolute GHG emissions, rather than in terms of carbon intensities. The yearly targets are therefore calculated thanks to the following formula:

$$CE_y = CE_b \times \frac{SE_y}{SE_b}$$

with CE_y: absolute CO_2 emissions of the company in year y
SE_y: absolute CO_2 emissions of the sector in year y

As far as scope 2 emissions are concerned, the formula does not change for heterogenous sectors, but for homogenous sectors, the sectoral scope 2 intensity is calculated as follows:

$$SI_{scope\ 2,y} = \frac{PS_y \times SI_{power,y}}{SA_y}$$

with PS_y: energy consumption of the sector in year y (MWh)
$SI_{power,y}$: intensity target for the power sector in year y

[7] Sectors for which the quantification of the activity with a physical indicator is impossible, and so is the comparison between companies' activity levels.

Then, for scope 3 emissions, the SBTi made some recommendations and calculated CO_2 budgets for most of the emission categories, available in Annex 1. We can see on this table that for most of the emission categories, the recommendations for target setting consist in applying the targets calculated for the scopes 1 and 2 for the concerned sector. We will follow these recommendations for our case studies.

After having explained the theory behind the calculation of yearly absolute or intensity targets, here is an example of a sector's carbon pathways from 2010 to 2050:

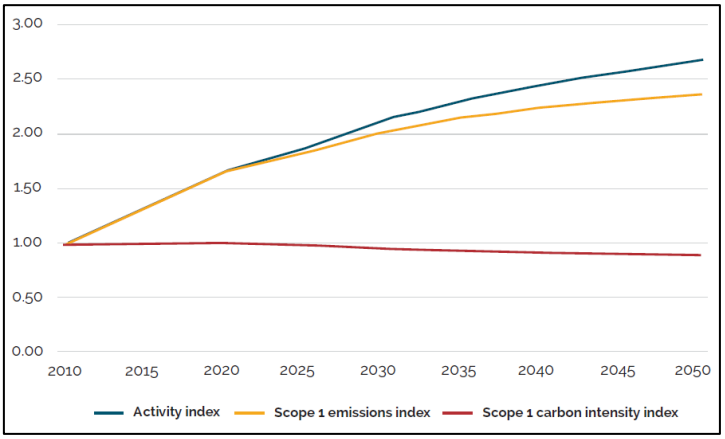

Figure 1.4. Aluminium manufacturing industry sector's intensity pathway (SBTi, 2015)

From the previous graph, we understand that the overall production of the aluminium manufacturing sector is expected to increase from 169%, and absolute scope 1 emissions should only undergo a 136% increase, therefore the scope 1 carbon intensity of aluminium manufacturing should decrease by 19.5%. Then, we can calculate the target in terms of scope 2 CO_2 emissions: this sector must shift towards an 88% reduction of scope 2 CO_2 intensity to meet the calculated CO_2 emissions from Table 1.1. This decarbonisation of the energy sector is depicted by the following figures, showing a 2DS trajectory for the energy's carbon intensity:

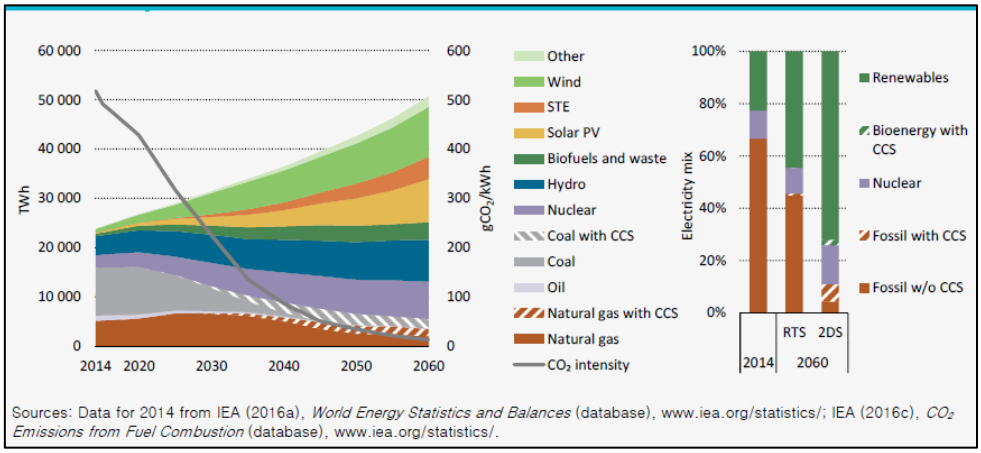

Figure 1.5. Global electricity generation in the 2DS scenario (IEA, 2017)

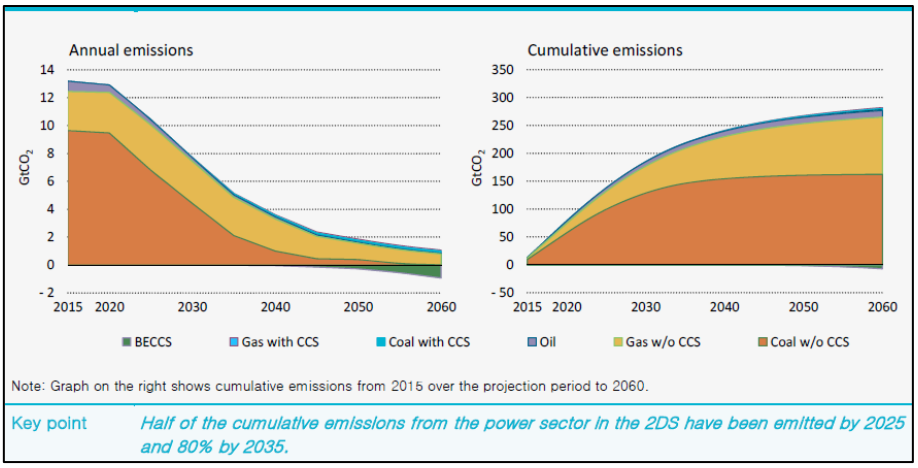

Figure 1.6. CO_2 emissions from the power sector in the 2DS scenario (IEA, 2017)

Similarly to what we have seen before, we can study the absolute and intensity emission pathways for other sectors. In order to introduce the case studies that will follow this part, I chose to display the IEA's pathways for the service sector and the light-duty road passenger transport sector:

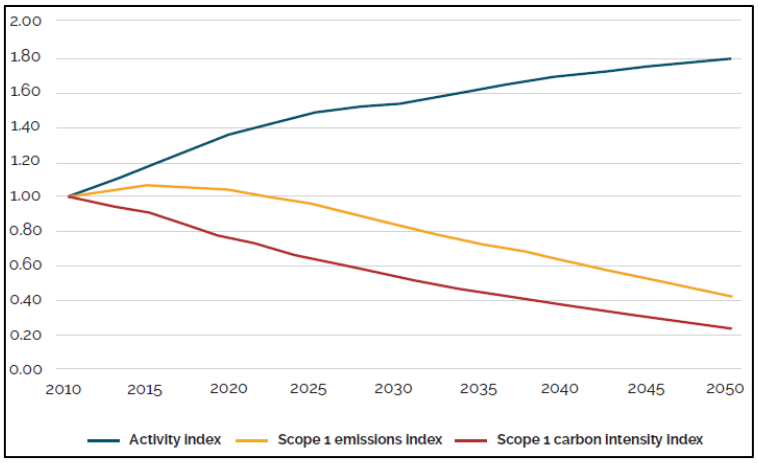

Figure 1.7. Light-duty road passenger transport sector's intensity pathway (SBTi, 2015)

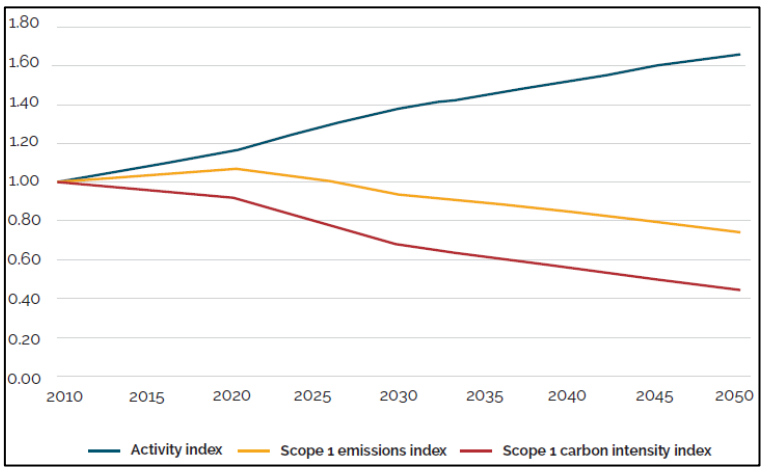

Figure 1.8. Service sector's intensity pathway (SBTi, 2015)

As can be seen above, the absolute emissions and carbon intensities are expected to decrease for both sectors by 2050. The percentages of decrease have been gathered in the following table:

Sector	Absolute emissions	Carbon intensity
Light-duty road passenger transport	-58%	-76%
Services	-26%	-55%

Table 1.2. Expected variations of GHG emissions by sector between 2010 and 2050 (SBTi, 2015)

Even though the IEA is an autonomous intergovernmental organisation and the SBTi is also independent, some of the measures recommended for the 2 degrees aligned trajectories depend on political and scientific choices (Tilsted et al., 2023). Therefore, one could argue that this framework is not objective or contradictory with some recommendations, while another trajectory, considering other hypotheses and choices, would also be possible to meet the Paris Agreement objectives. Indeed, the IEA scenarios are facing criticism within the scientific and environmentalists' communities.

For example, if we take a look at the intensity pathway for the aviation transport sector, we can see that the IEA expects a growth in terms of sector's activity:

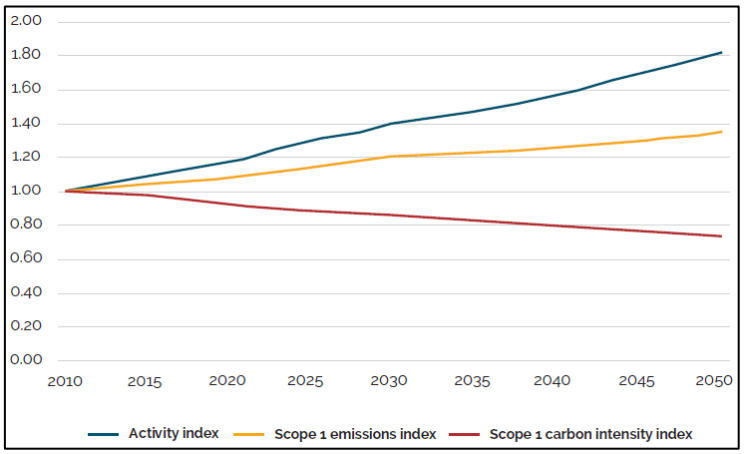

Figure 1.9. Aviation transport sector's intensity pathway (SBTi, 2015)

This goes against the idea of reducing airplane traffic by 2050 in order to limit the GHG emissions from the transport sector[8] (Hickel, 2021). Moreover, consequently, such an activity growth is expected to only be accompanied by a 26% decrease in terms of carbon intensity, leading to increasing absolute carbon emissions over the years for this sector.

1.2.2. Net-Zero Initiative (NZI)

This initiative is a global effort to achieve net-zero GHG emissions by 2050, as recommended by the IPCC in order to limit global warming to +2°C, based on three pillars. One of its main principles is that companies must all contribute to:

[8] This goes against the idea of sobriety action for climate, as the IPCC recommends in its AR6 (IPCC WG III, 2022).

- Reducing their GHG emissions (scopes 1&2 and at least part of scope 3) by changing their processes, purchases and eventually business model (Pillar A).
- Reducing others' GHG emissions, which can also be accounted as "avoided emissions", by selling goods and services with low carbon intensity and financing reduction/avoidance projects (Pillar B).
- Participating in carbon capture development, directly, indirectly or by financing carbon removal projects (Pillar C).

The idea is that all the companies' remaining GHG emissions have to be balanced by removing or offsetting an equivalent amount of emissions from the atmosphere, but that the term "net-zero carbon emissions" only makes sense at a national/global level and therefore shouldn't be used at a company level, to avoid greenwashing.

To reach this target, society must undergo a transformation of each sector: transport, agriculture, industry, energy, … but these transformations do not only have to consider environmental concerns but also the social and economic impact of this transition, especially on vulnerable populations. Hence, every company must set ambitious goals consistent with the +2°C global target.

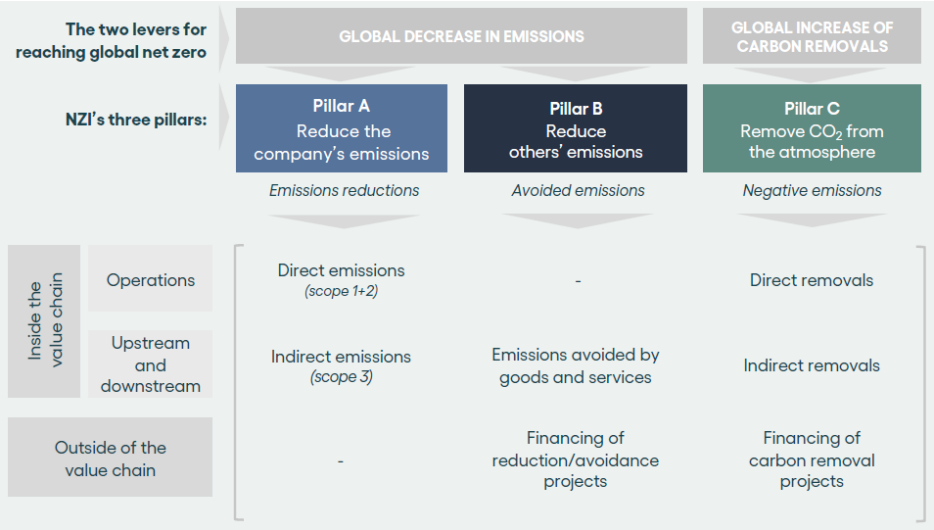

Figure 1.10. The Net Zero Initiative dashboard (NZI, 2021)

On the Figure 1.10, we can see that each pillar is sub-divided in three categories. For pillar A (resp. B & C), the "operations" category will be referred to as A1, the "upstream and downstream" category as A2 and the "outside of the value chain" category as A3. Then for each pillar, we can set three different advancement steps: "Measure", "Set targets" and "Manage and assess performance":

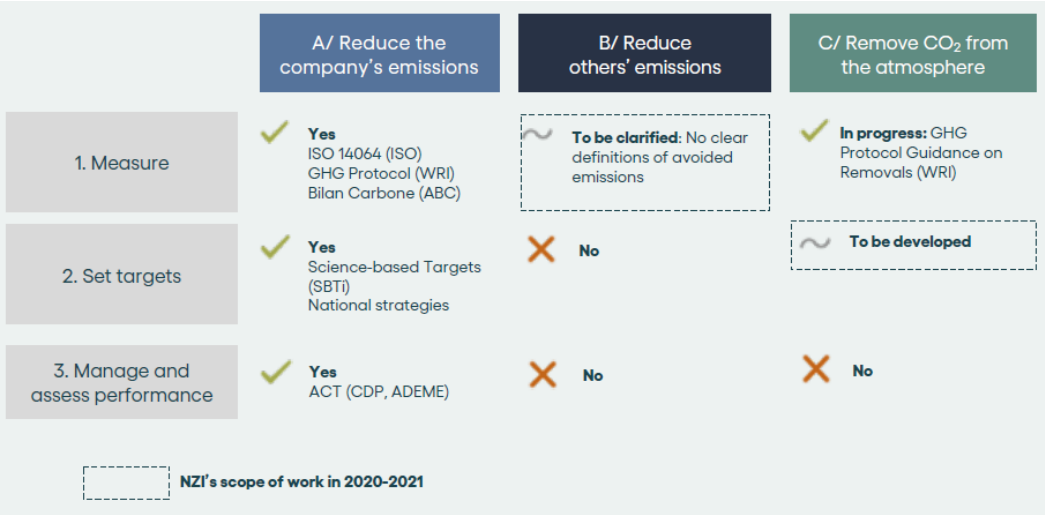

Figure 1.11. Maturity of the different pillars (NZI, 2021)

As far as climate mitigation is concerned, the NZI focuses more on establishing methods for pillars B and C, while for pillar A companies are asked to refer to existing methods:

- ISO 14064, GHG Protocol and Bilan Carbone for measuring
- SBTi and national strategies for setting targets
- ACT for managing and assessing performance

The NZI is still under development, and the last published report provides methods to measure avoided emissions and to set carbon removal targets at company level. Thus, target setting for avoided emissions, and performance assessment and management for both pillars B and C are yet to be developed.

Concerning pillar B, the NZI distinguishes real avoided emissions from lesser increase avoided emissions. While both terms refer to a positive difference between the emissions associated to a baseline scenario and those of a scenario of a project implementation, in the first case, the emissions with the project are lower than emissions in the past and, in the second case, they are higher.

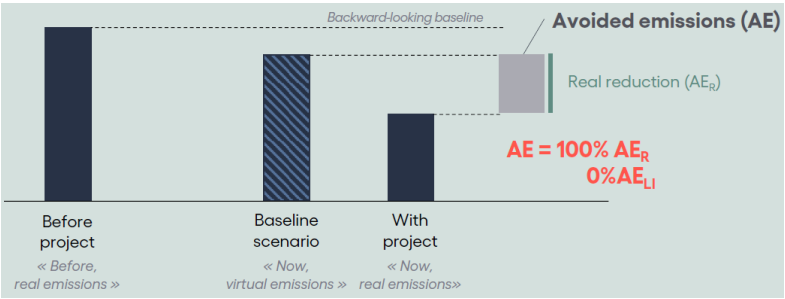

Figure 1.12. Real avoided emissions (AE_R) (NZI, 2021)

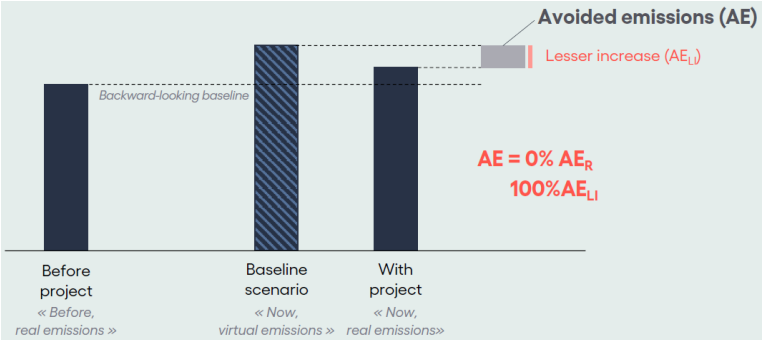

Figure 1.13. Lesser increase avoided emissions (AE_{LI}) (NZI, 2021)

For pillar C, the NZI defines a method to set carbon removal targets at company level. This method, similar to the one of carbon intensity used by the SBTi, consists in using the GHG emission trajectory defined by pillar A and an absorption/emission ratio corresponding to a +1.5°C or +2°C scenario. This ratio depends on the territory where GHG emissions take place. In case of emissions taking place in several countries, the ratio is calculated as the pro-rata of ratios of each country where GHG are emitted.

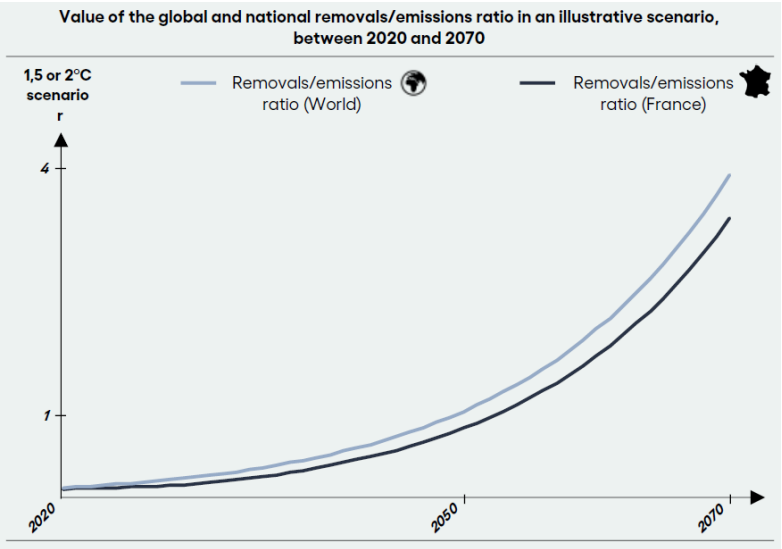

Figure 1.14. The absorption/emission ratios from 2020 to 2070, compatible with a +1.5°C or +2°C scenario (NZI, 2021)

It is yet important to note that the NZI recommends to companies with carbon sinks in their value chain not to set their targets according to this ratio and therefore according to their pillar A targets, but to be more ambitious, as they have an important role to play in carbon removal and in general in achieving carbon neutrality at a global scale.

Overall, this method refers to the +2°C target related to the IPCC's RCP2.6 scenario and refers to the SBTi for target setting. Its purpose is to address the global climate change issue, but its approach is broader than the ACT-S method, as it recommends both corporate climate change mitigation at company

level (pillar A), but also outside of the company (pillar B) and a contribution to carbon sinks development (pillar C) to reach net-zero GHG emissions. Hence, this initiative completes ACT-S with the two last pillars and therefore the two methods are compatible and even complementary. However, it is still under development in 2023, so it may be difficult to apply it today, but it seems promising for the establishment of CCMSs in the future.

1.2.3. Urban LEDS (Low Emission Development Strategies in Brazil, India, Indonesia, and South Africa)

This initiative is implemented by the United Nations Development Programme (UNDP) and the World Resource Institute (WRI). It deals with four aspects at national, regional and city levels: climate commitments by countries are not ambitious enough to address the climate emergency problem (that is to limit global warming well under +2°C and tend to a +1.5°C increase), but that commitments at much lower scale (such as cities, regions, and businesses) are. Indeed, when aggregated, the targets set at this scale are likely to meet the +2°C target (UN Habitat, 2020). Therefore, the idea is to sub-divide climate mitigation responsibility at local scale to have a better efficiency and ambition. The objectives in terms of GHG emission reduction are those set by the countries (and often more ambitious ones set by cities or local communities), themselves derived from the IPCC's 6th Assessment Report and from 2015's Paris Agreements on Climate Change.

The Urban LEDS Initiative seeks to assist cities in lowering greenhouse gas emissions while fostering social and economic advancement. The program helps cities in poor and emerging economies construct and execute LEDS by offering technical assistance, capacity building, and peer-to-peer learning opportunities. LEDS typically consist of a mix of legislative and administrative actions, financial investments in low-carbon infrastructure, and alterations to consumption and behaviour patterns. All these actions fall behind three major pillars, ruling the initiative: *Analyse*, *Act*, and *Accelerate*.

Here, the initiative is not a method to directly elaborate a climate mitigation plan but is a programme which aims at supporting local authorities in this elaboration process. Thus, in addition to the fact that this initiative targets CCMSs for cities instead of companies, the scope and goals of Urban LEDS differs from ACT-S as it represents a third-party help for the establishment of CCMSs. If we can pinpoint the lack of precision of this programme to set CCMTs, its adaptability to various territories needs to be highlighted. Furthermore, this initiative is both *IPCC-derived* (UN Habitat, 2022; UN Habitat, 2020) and *experience-based*, because relying on success-stories from other cities: an asset that ACT-S does not bear (at least not in its current version). We could imagine the creation of such a programme, adapted to ACT-S, to help organisations elaborate their CCMS thanks to feedback from precedent experience and common recommendations by sector (or even sub-sectors)[9].

1.2.4. Task force on Climate-related Financial Disclosure (TCFD)

The Task force on Climate-related Financial Disclosure, or TCFD, was created in 2015 after the G20 Finance Ministers ordered the Financial Stability Board (FSB) to review how the financial sector could take climate-related issues into account (TCFD, 2022). To do so, the task force gathered opinion and experiences from various stakeholders from public and private sector, and produced in 2017 their first report, constituting a framework for companies to improve their current financial disclosure by including climate-related issues. This framework, updated several times since (latest version dating from 2022),

[9] Today, such recommendations exist in the SBTi but need to be developed for ACT.

aims at establishing guidance regarding climate-related metrics and targets, and transition plan disclosure. This framework is voluntarily broad, as the TCFD wanted it to be applicable worldwide and therefore be in accordance with potential local recommendations or regulations. Hence, it establishes a basic scope for climate-related financial disclosure, so that the latter are pertinent and comparable between two companies (from the same economic sector or, in certain cases, from different ones).

As far as climate-related metrics are concerned, several indications are given on how to choose and disclose them. First, a list of fundamental characteristics is given so that these metrics describe best climate-related issues and risks linked to the company (TCFD, 2021). In particular, climate-related metrics should, according to this document, be:

- Decision useful: *relevant to the organisation's risks and opportunities and show how this organisation manages them.*
- Clear and understandable: *supported by contextual and narrative information on the organisation's boundaries, governance, methodologies, and basis of preparation.*
- Reliable, verifiable, and objective: *free from bias and value judgement*
- Consistent over time: *containing three-time frames, namely "current", "historical" and "forward-looking" (with short, medium, and long-term horizons)*

Concerning the disclosure of these metrics, organisations should provide several information such as the types of measurements used (*direct, estimates, proxy indicators, …*), the methodologies and definitions used (*scope of application, sources, critical factors, and parameters, …*) and the trend of data (*show how metrics have changed in absolute and relative amounts*). Additionally, in order for them to be comparable between organisations, the TCFD recommends companies to choose seven cross-industry metric categories, to support convergence in key metrics' disclosure. They are the following:

- GHG emissions
- Transition risks: *"Amount and extent of assets or business activities vulnerable to transition risks", that is to "the risk of policy, law, technological, and market changes brought about by the low-carbon economy"*
- Physical risks: *"Amount and extent of assets or business activities vulnerable to physical risks", that is to "the risk of financial losses caused by extreme weather events".*
- Climate-related opportunities: *"Proportion of revenue, assets, or other business activities aligned with climate-related opportunities"*
- Capital deployment: *"Amount of capital expenditure, financing, or investment deployed toward climate-related risks and opportunities"*
- Internal carbon prices: *"Price on each ton of GHG emissions used internally by an organisation"*
- Remuneration: *"Proportion of executive management remuneration linked to climate considerations"*

Then, the TCFD sets a list of fundamental characteristics that climate-related targets should bear. In particular, they should be:

C8. Aligned with strategy and risk management goals.

C9. Linked to relevant metrics: *in order to measure and track progress over time, and assist with periodic reviews*.

C10. Quantified and measurable.

C11. Clearly specified over time: *targets should include a baseline, a time horizon, and interim targets (with for example 5 to 10 years intervals)*.

C12. Understandable and contextualised.

C13. Periodically reviewed and updated: *companies should have a clear process for reviewing climate targets, at least every 5 years*.

C14. Reported annually (at least)

Box B4. Fundamental characteristics of performant corporate climate-related targets (TCFD, 2021)

Additionally, in the case in which some information should remain confidential (in order not to harm the organisation's business or advantage over the concurrence for example), the company should provide additional relevant and sufficient information for users to still be able to make decisions concerning the reachability of the targets set by this company.

The overall goal hidden behind these recommendations is to encourage companies to assess the risks and opportunities related with climate change and low carbon transition that this organisation is currently and will be exposed to. This would allow them to determine the potential financial impacts related to climate change. To this extent, defining climate-related targets and using climate-related metrics help organisations understand and disclose these potential financial impacts and the strategy put in place to deal with them.

In short, the TCFD gives a wide framework to help financial impacts assessment and disclosure methods merge into a unique and comparable one. This would allow the uniformity of published reports, contributing to a better understanding of risks and impacts for consumers and stakeholders. Moreover, the strength of this initiative lies in the fact that it has been created by gathering data, information and opinion from various stakeholders, therefore making the framework both experience-based and aligned with scientific recommendations. However, the TCFD only gives some recommendations concerning methods to use to carry out the risks assessment rather than limiting to only one, which can be confusing. Overall, this framework's scope is a bit different from the one of ACT-S, as the objectives of each initiative are different, but the TCFD gives useful information and recommendations as far as the monitoring and disclosure of climate-related strategies is concerned. Indeed, it provides metrics and indicators that can be used for these purposes, giving coherence and comparability between the results of different companies (mostly within the same sector). Therefore, we cannot compare the performances of the TCFD to the ones of ACT-S, but we can state that the two initiatives are compatible and even

complementary, and we can recommend the use of the TCFD for the establishment and disclosure of CCMSs. ACT-S covers a broader range of elements but was inspired by the TCFD for its strategy analysis part.

1.2.5. EUCRA (European Union's Climate Risks Assessment)

Climate Risks Assessment is an initiative from the European Union, part of the EU Adaptation Strategy, launched on September 15th, 2022, aiming at gathering and complementing the knowledge on territorial and corporate climate-related risks. It will be a comprehensive approach to assess and manage climate risks in various sectors and industries. It will consist in the identification, analysis and prioritisation of climate-related threats and their potential impacts (on ecosystems or infrastructures). Its final aim is to provide decision-makers with information that can inform risk management strategies and help them to develop adaptation measures, such as investments in infrastructures, changes in management strategies or changes in land use. The publication of this method is scheduled for spring 2024.

In concrete terms, this initiative will consist in several steps:

- A baseline assessment of the currently existing climate risks
- A scenario development, exploring the potential impacts of future climate scenarios
- An evaluation of the vulnerability of the system under study (city, infrastructure, company, …)
- An assessment of the potential consequences of the identified risks

Overall, the EUCRA is very different from ACT-S, as its aim is not to address the climate change issue, but rather to identify the hazards related to this one, to elaborate better strategies, both in terms of mitigation and adaptation. Indeed, this initiative will give a framework to systematically evaluate climate risks related to small scale systems and to identify appropriate responses. Therefore, it appears pertinent to be used in complement to ACT-S. However, as this method has not been released yet in 2023, companies will have to compose their CCMSs with other risk assessment methods for the moment.

1.2.6. SWOT (Strengths, Weaknesses, Opportunities, and Threats) method

The SWOT method is an analysis method widely used in strategic planning. It was invented in the 1960s by three persons at the Stanford Research Institute. It aims at identifying internal and external factors which could either harm or help the company's business (in our scope of study). It consists in listing elements in four categories: Strengths (*internal, helpful*), Weaknesses (*internal, harmful*), Opportunities (*external, helpful*), and Threats (*external, harmful*). A 2×2 matrix can be used for the visualisation of these elements:

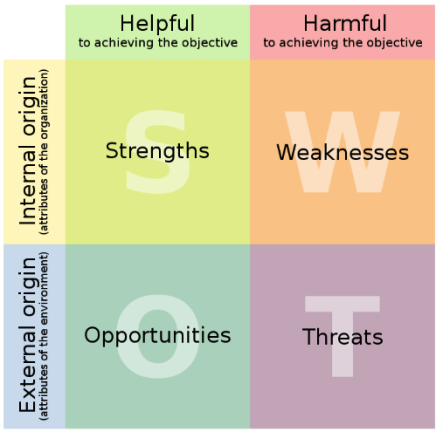

Figure 1.15. Illustration of a 2×2 SWOT matrix

Then, in our context, companies would have to consider their climate-related weaknesses and threats for the elaboration of their CCMS, and evaluate the likelihood of these risks occurring, and their associated impacts.

This method's scope is narrower than ACT-S's, as it only deals with risk assessment and the prioritisation of mitigation measures to be taken. Moreover, the SWOT method has been integrated to ACT-S, in its "*Strategy* Toolbox" tool.

1.3. Recommendations for the elaboration of a CCMS

With the previous frameworks studied and ACT-S' structure, we can constitute a list of steps – mandatory or optional – that organisations should follow when building and implementing a corporate climate change mitigation strategy. For each step, when necessary, I will add a suggestion of initiative, framework, methodology or tool that can be used to carry it out. The latter will be made in accordance with what has been studied and mentioned before in this report. Other methods and tools could exist and be as – if not more – efficient, but as I said it is just a suggestion: the ones companies will actually use are up for them to choose. In addition to corporate emission reductions, measures aiming at developing carbon sinks and at adapting to climate change risks.

I proposed the following flowchart displaying all these steps and tools to perform them, to better understand and visualise the processes behind CCMSs' establishment, implementation and monitoring:

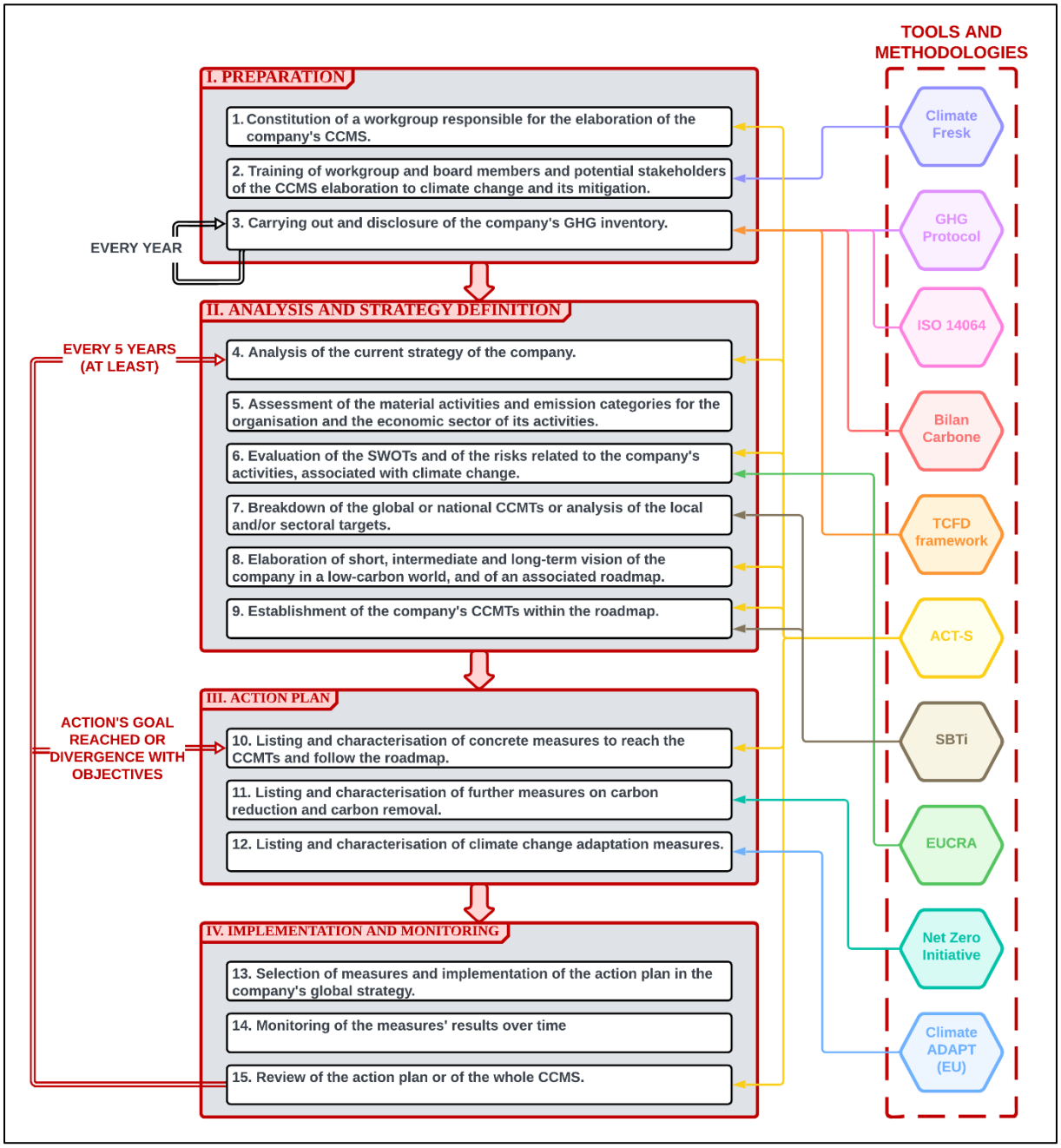

Figure 1.16. Recommendations for the elaboration of a corporate CCMS

For each step, the link with the tools and methodologies is not mandatory or standardised but reflects the recommendations of the ACT Initiative and my research on the various topics covered by this list of steps. The description of each step is given by the following table:

Step number	Description and explanations	Tools and methodologies recommended
1.	The workgroup should include members of the board of the company, top managers, and it is recommended to also include employees or managers from each section. This workgroup should be led by a designated person or group (and this task must be written in the job description).	*ACT-S*
2.	With this step, we want to make sure that everyone involved in this project have a solid understanding of the climate change topic, of what is at stake with this issue, and of how can this problem be address through CCMSs.	*Climate Fresk*[10]*; ACT's initial formation*
3.	The GHG inventory should concern all material emissions in scopes 1 and 2, and 3. This assessment will constitute the reference for the GHG emission levels in the CCMS. Then, the results of this inventory and potential analyses should be disclosed publicly.	*GHG Protocol; ISO 14064; Bilan Carbone; TCFD framework*
4.	In case the company already has a strategy taking climate change into account, it is interesting to assess whether the latter is already performant or not, and which points of the latter it should focus on in priority.	*ACT-S (1B)*
5.	Roughly, material emission categories represent the biggest categories for the organisation. For the activities, it corresponds to its main economic activities (biggest revenues or carbon intensities). These categories and activities will then be the subject of priority emission reductions.	*Analysis of the GHG inventory and breakdown of financial/production data*
6.	This step aims at providing a better understanding of what is at stake for the organisation when dealing with climate change: *changes on its activities, its infrastructures, etc.*	*EUCRA*[11]*; ACT-S (with the SWOT method: 2C)*
7.	This allows the orientation of organisations towards specific and adapted corporate climate change mitigation targets (depending on their size, activities, geographical situation, etc.). These targets are often more ambitious than the global and/or generic climate change mitigation strategies. Therefore, it is more pertinent to use the latter when it comes to setting its CCMTs. However, if they do not exist, the company should refer to generic transition plans and recommendations.	*Local or national climate change plans and policies*[12]*; SBTi*
8.	For this step, the company combines information from steps 6 and 7 to imagine what would be its position and in a low-carbon world, in the short, intermediate and long-term. This will allow the building of a roadmap with regular milestones depicting this vision, that the company will have to follow.	*ACT-S (3A & 3B)*
9.	By using the requirements and benchmarks in terms of CCMTs and the roadmap priorly set, the company will here establish its own CCMTs, for the short, medium and long terms. These CCMTs should be at least aligned with +2°C national and/or sectoral trajectories, and coherent with the roadmap.	*ACT-S (4A); SBTi*

[10] The Climate Fresk is a tool created in 2015, taking the form of a game, to educate and raise awareness of climate and climate issues (the origins, the associated geo-physical-chemical processes, and the consequences). More information about the Climate Fresk available on their website: https://climatefresk.org/.

[11] When released to the public (announced for spring 2024).

[12] The different local and national climate policies (along with other climate and energy related ones) have been gathered by the NewClimate Institute and can be accessed here: https://www.climatepolicydatabase.org/policies.

10.	These measures should concern short-, medium- and long-term time scopes, and be in accordance with global, national, local, and sectoral climate change mitigation targets – set as regulations or recommendations –, i.e., they should be in accordance with a sub-2°C global warming scenario and the roadmap priorly defined.	*ACT-S (4B), TCFD*
11.	This step should complete the previous one with climate change mitigation measures for other companies (with investments, partnerships, and commitments), and carbon removal measures.	*Net Zero Initiative; Corporate Net-Zero Standard (SBTi)*
12.	These measures both aim at limiting the threats to the company which could impair its activities, and at preparing its different infrastructures and supply chains to the changes which will occur in the environment due to climate change.	*Climate ADAPT (EU)*[13]*; ACT Adaptation*[14]
13.	This step corresponds to the selection of the best measures of steps 10 to 12, and the commitment of the company's board to both the strategic roadmap and the action plan thus built. The latter should be officially added to the company's overall strategy.	*ACT-S (5A & 5B)*
14.	Here, the company uses the indicators and metrics determined in steps 10 to 12 to measure if the actions are effective and if their associated objectives are reached.	*ACT-S (5C)*
15.	If the company observes divergences between the objectives and what is monitored, it should change its action plan to be as close as possible to the target scenario. If a goal is reached, new actions should also be implemented. Otherwise, the CCMS should be entirely reviewed at least every five years, to adapt to the new specificities of the market and the new technologies and practices.	*ACT-S*

Table 1.3. Description of each step of the elaboration and implementation of corporate CCMSs

We have seen here that the ACT-S methodology has an important role to play in the establishment of CCMSs, as it is useful in 7 steps out of 15, and as the methodology covers at least 9 of these steps. To that extent, I decided to study it in detail to understand how it works, what is it based on, and to analyse its potential gaps and drawbacks. The following part will be dedicated to this work.

[13] But these frameworks and recommendations are yet to be published.

[14] As I mentioned earlier, the "adaptation" part of climate change strategies is out of the scope of this thesis, therefore, I did not put more detail about the ACT Adaptation methodology. Also, the latter is still under development and only a draft is currently available: *https://actinitiative.org/wp-content/uploads/pdf/act-adaptation-methodology_final-for-roadtest_june2022.pdf*.

2. Analysis of ACT-S methodology

2.1. General presentation

Assessing low Carbon Transition (ACT), is an initiative jointly launched by the CDP (Carbon Disclosure Project) and the ADEME (French Environment and Energy Management Agency) in 2015, as part of the UNFCCC's Agenda. This initiative was born in a context in which organisations were disclosing the climate impacts of their activities with different methods and metrics, leading to little to no comparability between the results thus obtained. Yet, as corporate GHG emissions were and are still growing, having a unique methodology for carbon accounting and reporting, establishment of low carbon trajectories and efficient corporate CCMSs became more and more urgent. The CDP also noted that while more than 80% of Global 500 companies[15] had set targets to reduce their GHG emissions in 2010, 50 of the largest emitters among them (representing 70% of Global 500's total emissions) have known an increase in their GHG emissions between 2010 and 2015. This showed that the methods used to elaboration, CCMSs were inefficient. Within this scope, the creators of the ACT initiative decided to create a method to close these gaps and lead corporate's economies toward a below 2°C pathway[16], which would be based on five key principles: *relevance*, *verifiability*, *conservativeness*, *consistency*, and *long-term orientation*.

ACT initiative is divided into two distinct methodologies: ACT step-by-step (ACT-S) and ACT Assessment (ACT-A):

The first one is a thorough methodology aimed at assessing and directing corporate transitions to low-carbon economies. It is intended to provide policymakers, corporations, and other stakeholders with a step-by-step process for methodically evaluating the numerous factors involved in decarbonisation activities. It includes a comprehensive analysis of existing carbon emissions, pinpointing the major industries and activities that produce large amounts of emissions. The ACT-S methodology makes it possible to identify particular mitigation techniques and strategies that can be used to accomplish emissions reductions by utilising a thorough examination. The methodology is broken down into a broad range of sector-specific methods, such as various industries (energy production, cement, agrifood, automobiles, iron and steel), building, real estate and retail, therefore focusing on key points or action relative to the activity of the organisation, to better target the mitigation measures. *"The objective of ACT-S is to provide guidance and support for companies to prepare, structure and implement their decarbonization strategies."* (ADEME, 2021)

The second one aims at rating already existing CCMSs. Hence, it is not suited for companies which are in an early stage of CCMS establishment. It is based on a series of criteria and weights, attributed to different categories, going from the organisation's emission reduction targets engagements to its investments in R&D and low carbon technologies and projects, passing by its overall business model or even the engagements of clients or suppliers. Identically as the ACT-S methodology, this notation method is broken down into various sector-specific methods, therefore considering means and ends relative to each economic sector. Then, the assessment gives organisations a three-part score: a performance score from 1 to 20, depicting the overall pertinence of their CCMS, a narrative score from

[15] The Global 500 is a group composed of the 500 (thus the name) biggest corporates by market capitalisation, created in 2018. Within this sample, 366 companies (73%) had answered the CDP Questionnaire, a combination of qualitative and quantitative questions to assess the sustainability performance of companies. Nowadays, in total, 6,937 companies have answered this questionnaire (CDP, n.d.-b; CDP, 2019).

[16] In 2014, the IPCC evaluated that in a business-as-usual scenario, annual global GHG emissions would reach more than 100 $GtCO_2e$/year (54.82 $GtCO_2e$ in 2019 (Ritchie et al., 2020)), resulting in a +3.7°C to +4.8°C global warming index (Pachauri et al., 2015).

E to A, stating the performance relative to public engagement, transparency, and disclosure of results, and finally a trend score (+, - or =), showing the evolution of the score through time. Therefore, the best score possibly achievable is 20A+, and the lowest is 1E-.

As a first CCMS is needed to apply the ACT-A methodology, I proposed a flowchart of an ideal process of establishment and rating of CCMS for organisations with ACT initiative:

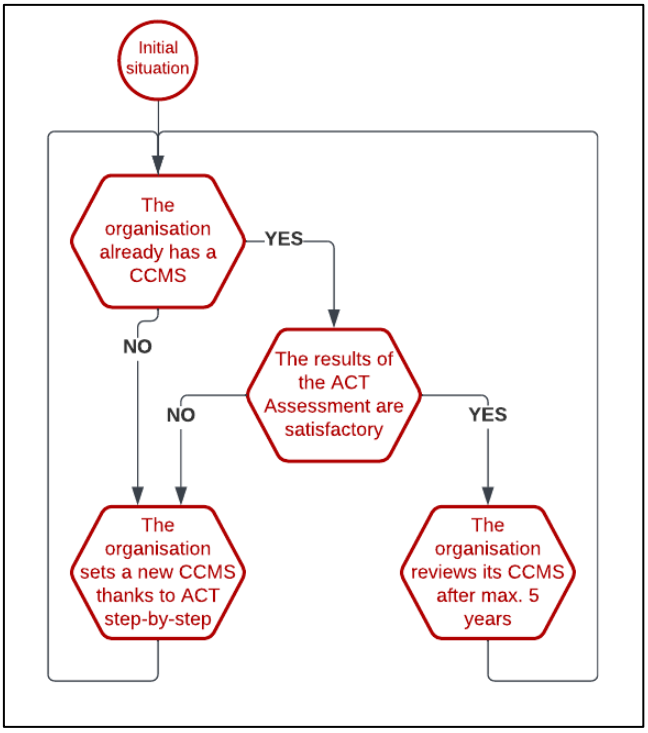

Figure 2.1. Flowchart of an optimal ACT application process

Here, we can see that the process is an infinite loop, because the CCMS elaboration process is iterative: regular reviews need to be done in order to always have efficient and adapted goals and action plan to reach them. This review either depends on the achievement of actions' goals (when finished, new actions need to be taken to comply with the company's short and long-term strategies), on time (every 5 years a review is necessary to update targets and mitigation measures as an adaptation to past trends) or on the quality of the CCMS.

On the previous figure, the criterion "the results of the ACT-A are satisfactory" is quite arbitrary. One could set the satisfaction criterion to be "having an ACT-S performance score higher than 15", and another could consider the CCMS satisfying if the associated CCMTs are aligned with the SBTi's +2°C trajectory. However, the company can refer to several elements to determine whether the CCMS in place is performant enough. First, if the CCMS establishment involved a third party (a consultant advisor, as we will see afterwards), the latter will be able to tell if this CCMS is and will be efficient to tackle climate change at corporate level. Also, we can reverse the problem and set criteria for a "non-satisfying" CCMS. For example, a CCMS can be deemed to be inefficient if its CCMTs are not at least aligned with a renowned +2°C trajectory. Furthermore, if the ACT-A narrative score is lower than C or if the trend score is "-", we could consider that this CCMS need to be reviewed and improved.

I would recommend the following set of criteria:

- Have an ACT-A overall score higher (or equal to) than 14B=
- Include CCMTs aligned with (at least) the generic or (if existing) the sectoral SBTi +2°C trajectory or WB2DS
- Comply with Abeysinghe's criteria on LTCSs (see part 1.1.3) and TCFD's fundamental characteristics on corporate CCMTs
- Be compatible with other CCMS and CCMT determination strategies and initiatives (e.g., national or regional recommendations, Corporate Net-Zero Standard, Net Zero Initiative, …)

As this thesis is focused on the determination of corporate CCMSs, we will only deal with the ACT-S methodology, the ACT-A being more a tool for organisations to compare their transition plans with other organisations (in the same sector or inter-sector).

2.2. Presentation of ACT-S

ACT-S is an assessment, discussion, planification and implementation process taking place in about 1 to 3 years, involving various actors from and related to an organisation, aimed at guiding and supporting it through the determination and implementation of its climate change mitigation strategy. The methodology is structured across four strategic levels, to guarantee both the good performance of the determined strategy and its integration to the overall strategy of the organisation:

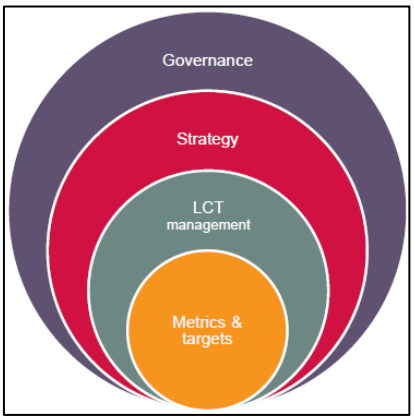

Figure 2.2. The ACT-S strategic levels (ADEME, 2021)

Thanks to this plurality of the strategic levels considered, this methodology is not limited to either the scientific or the economic aspects of the transition plan but encompasses all the elements necessary to build a corporate strategy. Indeed, it deals with nine pillars of transition strategies:

1. Targets
2. Material investments
3. Immaterial investments
4. Sold products performance
5. Management
6. Supplier engagement

7. Client engagement
8. Policy engagement
9. Business models

As can be understood with its name, the ACT step-by-step methodology consists in a series of steps for an organisation to take to determine an adapted CCMS. These steps are as follows:

1. Current situation
2. Issues and challenges
3. Vision
4. New strategy
5. Action plan

The following process map helps us understand better the order in which these steps have to be completed, the link between each one and the category in which they fall:

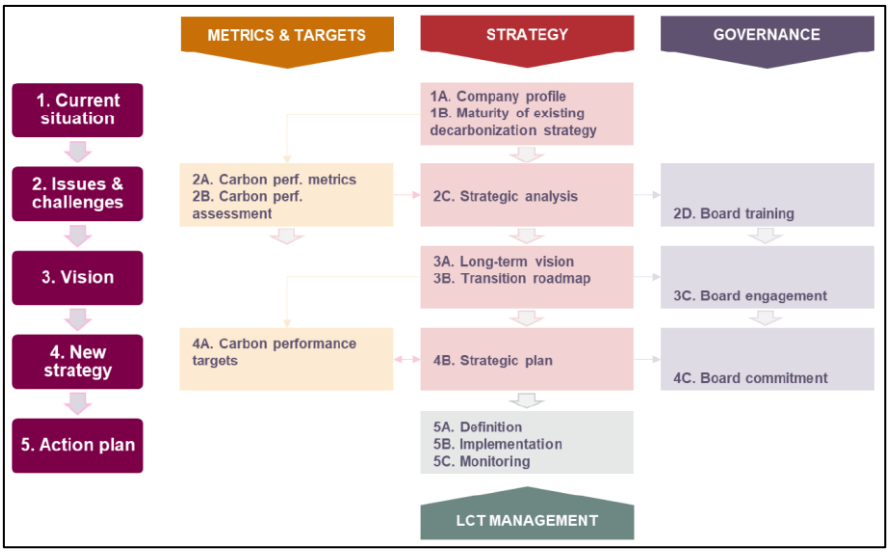

Figure 2.3. The ACT-S Process map (ADEME, 2021)

We understand here that the methodology has been thought to be in chronological order: the organisation first evaluates where it is in terms of low carbon transition, assesses the potential difficulties of a *business-as-usual* scenario for the future, and then composes with this assessment and its ambition to imagine a future environmental strategy.

In concrete terms, the ACT-S methodology will be applied by the organisation. The latter can decide to carry out the project on its own, or to be advised by a consulting company, helping with its expertise and previous experiences. External advisors will constitute some help for the company but will not prevent different actors of the organisation to participate actively to the development of the CCMS. Indeed, active discussions with all stakeholders, within and outside the organisation, are mandatory. The actors of the project are the following:

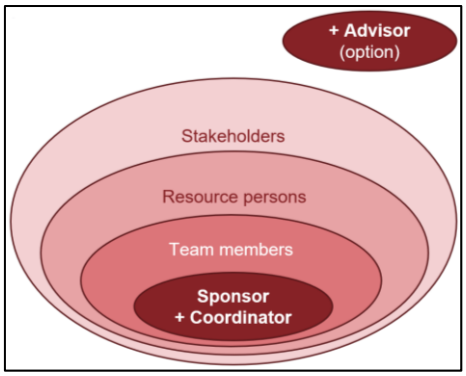

Figure 2.4. Actors of ACT-S projects (CDP, 2021)

- A sponsor, member of the board of directors, and a coordinator, usually from the middle management.
- A core project team, composed of representatives of the main functions in the organisation, supporting the previous duo.
- Resource persons, from the company, in charge of providing the useful data to the core team.
- External stakeholders (suppliers, clients, public local authorities, …) discussing with the organisation.
- ***Optional:*** an advisor, whose role will be played by an external consultant, helping the project team, and providing advice based on their knowledge and experience.

The ACT-S suite is composed of several elements, all essential to carry out an ACT step-by-step project:

- A **methodology**, a *55-page PDF file* explaining – among other things – how to carry out such a project, which actors to involve for each step, or which data to collect.
- A **progress grid**, an *Excel file* with guiding questions that the company will have to answer, which will help it fill the different maturity matrices. It is composed of 5 worksheets, corresponding to ACT-S's 5 major steps, plus some extra worksheets providing an overview and analysis of the results or templates for ACT-S recognition documents.
- A **strategy toolbox**, an *Excel file* helping the company for planning and brainstorming during steps 2 to 4 of the ACT-S methodology and the development of an action plan during step 5.
- A **carbon performance toolbox**, an *Excel file* where the company will input current data related to their activities, along with future targets in terms of activities, to then compare the quantified future emission targets with a sub-2-degree aligned trajectory automatically calculated by the tool.

As I considered that giving an example of the application of the tools would be more pertinent and make it easier to understand, more details about the methodology and the tools will be given throughout the case studies (in particular in the first one).

Along with all these tools, the ACT-S suite integrates external tools and methodologies that can be used for some steps. For example, in the carbon performance toolbox, has been integrated a worksheet with external resources concerning GHG emissions counting, target setting, assessment and reporting, and

establishment of action plans. These resources are broadly used national or international methodologies or databases that can be used for some steps of an ACT-S project.

Overall, the coverage of ACT-S's steps by each tool can be understood thanks to the following figure:

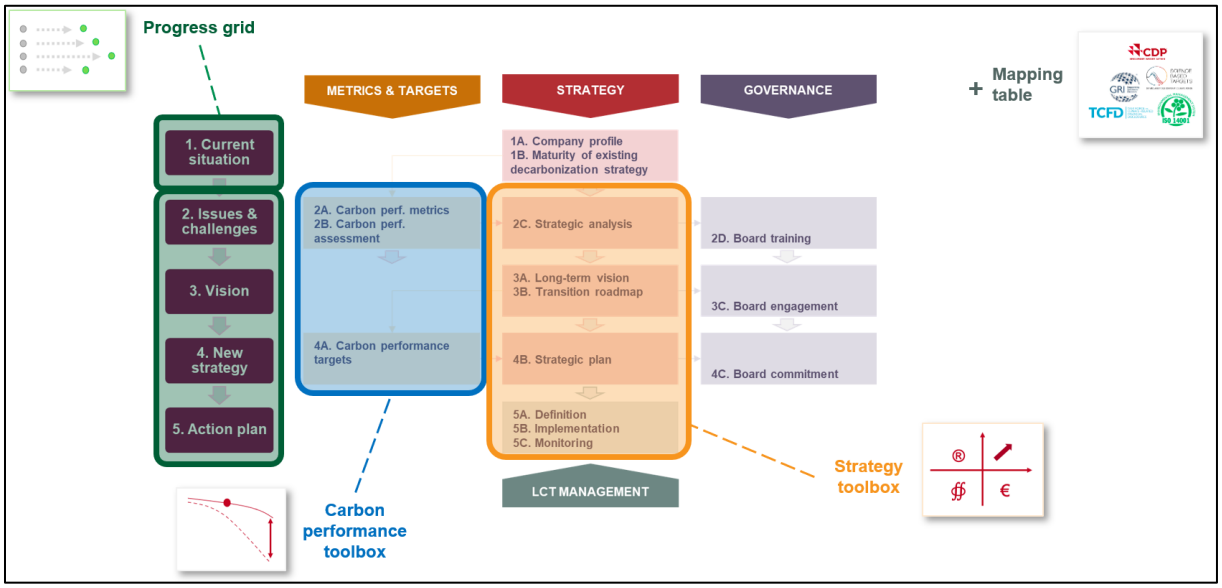

Figure 2.5. Overview of the coverage of the steps by the different tools of the ACT-S suite (CDP, 2021)

ACT-S, as opposed to other methodologies on CCMSs, does not only focus on target setting, but also covers different aspects of strategy building, which are depicted by each of its steps and sub-steps. Now that we mentioned the toolboxes going with each of them, we will try to comprehend better the scope and goal of these steps.

2.2.1. Step #1 – current situation

This step's purpose is to describe the maturity of the company's existing CCMS, based on its sector, its GHG profile and its action levers. This is done by considering a series of information about the company and carrying out the diagnosis of the *Progress Grid* toolbox.

This step covers ACT's nine pillars of transition strategies, and is subdivided in two sub-steps:

1A. Company profile: *choice of the Progress Grid toolbox's guiding questions by inserting basic information about the company.*
1B. Maturity of existing decarbonisation strategy: *response to the guiding questions to assess the company's CCMS's maturity.*

2.2.2. Step #2 – Issues & challenges

With this step, the goal is to analyse the current strategy, explore the related issues and challenges, and inform the company's board of the outcomes of the analysis. It will help the company to better manage and monitor its carbon performance.

This step contains four sub-steps:

> **2A. Carbon performance metrics:** *identification of relevant metrics and benchmarks for the company's carbon performance.*
> **2B. Carbon performance assessment:** *assessment of the company's carbon performance (using the metrics priorly determined).*
> **2C. Strategic analysis:** *identification of the company's SWOTs (Strengths, Weaknesses, Opportunities and Threats) for the low carbon transition.*
> **2D. Board training:** *training of the board on climate change and its mitigation by companies (including company's specific stakes related to the GHG inventory and the SWOTs previously identified).*

Here, the type of training chosen for the board can depend on their sensitivity to climate change and of their level of knowledge about this issue and its mitigation. To this extent, the ACT-S recommends various methodologies and documents ("discovery-level" and "expert-level" resources).

2.2.3. Step #3 – Vision

During this step, the company will build its vision of how it would look like in a low-carbon world. Along with the company's board and various other stakeholders, the ACT-S workgroup will imagine a transformation of the company's activities and business model, in the short, medium (with intermediate milestones) and long terms.

This step is subdivided in three parts, which are:

> **3A. Long-term vision:** *development of a vision of the company in a low-carbon world, based on climate change related challenges and on the companies SWOTs, by the board and the ACT-S coordinator.*
> **3B. Transition roadmap:** *identification of intermediate milestones for the company to reach in the short and medium term (intervals of 3 to 5 years for the next 20 to 30 years).*
> **3C. Board engagement:** *signature by the board of a formal document describing this roadmap*.

2.2.4. Step #4 – New strategy

The objective of this step is to translate the roadmap into concrete strategic objectives, orientations and policies. This step includes the establishment of CCMTs for the short, medium and long terms.

This step can be divided in three sub-steps:

> **4A. Carbon performance targets:** *setting of CCMTs with the metrics priorly identified (see step 2A), based on adapted benchmarks (i.e., sectoral recommendations on companies' carbon performance goals) and considering the transition roadmap built before.*
> **4B. Strategic plan:** *conversion of the first period of the roadmap into concrete strategy (objectives, orientations and policies), which should be consistent with the short-term CCMTs.*
> **4C. Board commitment:** *signature by the company's board of a formal document gathering all the information mentioned above*.

2.2.5. Step #5 – Action plan

For this ultimate step of ACT-S, the goal is to convert the strategic plan priorly built (see step 4) into an action plan. In concrete terms, it corresponds to the identification and selection of actions which could contribute to the implementation of the strategic plan, i.e., which may allow effective carbon emission reductions, consistent with the CCMTs the company has set. Finally, the company needs to put in place this action plan and monitor its efficiency, potentially modifying or adding elements to best fit the imagined GHG emissions trajectory.

This fifth step is subdivided in three sub-steps:

> **5A. Definition:** *identification of concrete actions that may contribute to the implementation of the strategic plan, and characterisation of these actions in terms of feasibility, costs, benefits and schedule. Then, these actions will be selected and added to the action plan.*
> **5B. Implementation:** *concrete implementation of the actions priorly identified and selected in the company's activities and management.*
> **5C. Monitoring:** *control of the results of the action plan's implementation.*

For the sub-step 5A, the company will characterise each identified action to select the best suited ones for the action plan. For this, ACT-S recommends that climate actions should be "ClimATE SMART":

- **Clim**ate impact: *will the action led to low, medium or high reductions in GHG emissions?*
- **A**cceptable: *is the behavioural change required by the action acceptable for the stakeholders?*
- **T**ransformative: *will the action produce some kind of business transformation?*
- **E**ngaging: *will this action favour the engagement of the stakeholders?*
- **S**pecific: *is the goal well defined?*
- **M**easurable: *how to know when the goal has been achieved?*
- **A**chievable: *are economic, technical and time resources available to reach the goal?*
- **R**ealistic: *is the goal realistic and within reach?*
- **T**ime based: *is the time target well defined?*

With all these elements, the ACT-S workgroup (and potentially stakeholders and employees as well) is able to select and prioritise the best actions of the company's action plan.

The last sub-step (5C) aims at informing the board and the ACT-S workgroup of potential improvements to be brought to the action plan. It does not require changes of all of the company's CCMS but only in the action plan.

2.2.6. ACT-S progress recognition system

Before dealing with the elements of methodology on which ACT-S is based, I wanted to mention the recognition programme that ACT put in place to "reward" companies engaged (at least) in an ACT-S process. This system first aims at recognising companies' progress in the elaboration of their CCMS with ACT-S. This recognition as three different levels:

- "Engaged": the company has initiated the ACT-S process (the board has clearly expressed its willingness to engage in the ACT-S project, and the workgroup has been at least partially constituted).

- "Committed": the company has carried out steps 1 to 4 and the board has committed to the new decarbonisation strategy (with new CCMTs).
- "Taking action": the company has defined a precise action plan to operationalise the new decarbonisation strategy and the board has signed it.

The recognition process is therefore constituted of three "checkpoints" and is illustrated below:

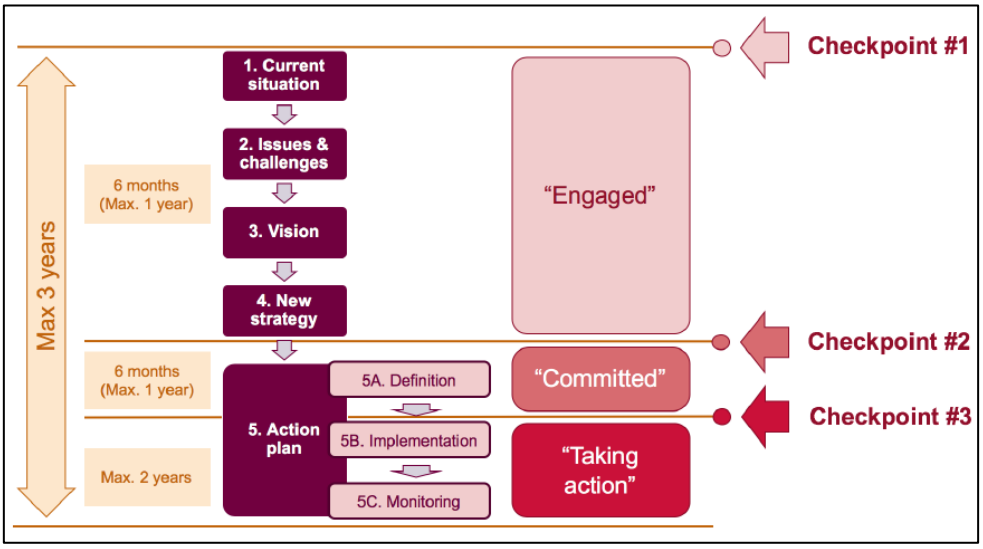

Figure 2.6. Illustration of the ACT-S progress recognition system (CDP, 2021)

It is important to note that with this system, the ACT Initiative only check the companies' engagement or commitment: the requisites for the checkpoints are the fulfilment of ACT-S steps and sub-steps. No assessment of the quality of the CCMS is carried out by ACT for the checkpoints 2 and 3. Therefore, the accreditation of companies with the different titles of this recognition system does not testify of an efficient strategy to tackle climate change.

Being granted with the different titles of ACT-S progress also rewards companies by including them in the public list of companies who engaged an ACT-S project and by authorising them to communicate publicly about this topic. Beyond these two rewards, the ACT Initiative wants to create a community gathering companies using ACT-S, in order to facilitate the sharing of experience, feedback, benchmarks and best-practices among them. This would constitute valuable help for companies to jointly tend to virtuous practices and broadly promote ACT-S and climate action in general. Yet, this platform has not been created yet. In 2023, this recognition programme is only used to verify companies' commitment to ACT-S projects and reward this engagement.

2.3. Elements of methodology: description, origin and analysis

After having described what the ACT-S methodology consist in, we will look at the elements it is based on. To do so, we will study these elements step by step. Some steps are not dependent on other methodologies or do not require specific explanation (e.g., step 4C on board's engagement on the strategic plan). Therefore, they will not be mentioned hereafter.

2.3.1. Maturity scoring (steps 1B, 3A, 4B and 5A)

The maturity scoring consists in a list of questions, oriented and adapted for each sector specific method, to which the ACT-S workgroup will answer – along with potential extra actors of the step concerned – aimed at assessing the maturity of the company and its CCMS for a step. These questions and the scoring system (with weights distributed among modules) have been developed by the ACT Initiative itself, based on their knowledge and analysis of the importance of each characteristic of a CCMS for a given sector. This grading system may seem a bit arbitrary, but it is the result of discussions and public consultations for each sector (with both companies, stakeholders, local and national representatives and citizens).

The maturity scoring is used at steps 1B (Maturity of existing decarbonisation strategy), 3A (Long term vision), 4B (Strategic plan) and 5A (Definition of the action plan).

2.3.2. Step 2A: Carbon performance metrics

For this step, the company and the ACT-S workgroup are asked to determine which metrics are the most adapted to set their targets and monitor their carbon performance over time. To do so, ACT-S expressed sector specific recommendations, which are based on the framework of the TCFD. The latter took its elements from a thorough knowledge of carbon reporting from a corporate point of view, making it adapted for our purpose. Additionally, ACT-S also relied on the SBTi for this part of its methodology, as they also have quite some experience in terms of metrics calculation (e.g., carbon intensity indicators) and performance indicators selection and reporting.

2.3.3. Step 2B: Carbon performance assessment

As far as the carbon performance assessment is concerned, ACT-S gives a method to analyse the company's current GHG inventory. This requires the collection of additional data such as performance indicators linked to the company's activities (e.g., products sold, revenues, investments, full time employees, …). This method has been created by the ACT Initiative and is based on the metrics selection from the previous step (and therefore on the TCFD and SBTi's recommendations) and on the CDP and the ADEME's background knowledge in terms of GHG inventory analysis.

2.3.4. Step 2C: Strategic analysis

For the strategic analysis, the ACT-S methodology is based on the SWOT method, described in part 1.2.6. The later consists in an enumeration of the company's exposure to external or internal risks and opportunities and their translation into a triangle of attention (risks and opportunities classified by likelihood and magnitude of impact to prioritise them).

This method has been proven to be effective in strategic analysis, as it allows an overview on the company's potential challenges in the future. However, this method seems to depend a lot of the company's ability to imagine and anticipate these challenges, and therefore on their knowledge of climate change issues and the induced evolution of the market).

2.3.5. Step 3A: Long term vision

For this step, the company must imagine its future in a low carbon world. To do so, ACT-S proposes a series of workshops aimed at enhancing the creativity of the workgroup members and other stakeholders of the project to help them envision better these potential evolutions: the *Catalogue of creativity techniques*. This catalogue gathers various commonly used methods for brainstorming, adapted to different types of workshops (time available, remote or in presence, …) and companies (number of participants in the project):

- **Disney's creative strategy:** *creates bridges between imagination and reality, iterative and collaborative process, and helps to avoid risks.*
- **Mind mapping:** *anonymous ideas, association of ideas lead to new ideas, and adapted to remote workshops.*
- **Reverse brainstorming:** *useful for complex problems, quick and allow main/priority decisions to be taken.*
- **Role storming:** *including a wide variety of stakeholders, and allow participants to share ideas without concerns.*
- **World café:** *for large groups, providing breadth and depth in ideas.*

2.3.6. Step 4A: Carbon performance

As far as the step 4A is concerned, the ACT-S methodology takes most of its elements from the SBTi (Science-Based Targets initiative). More specifically, the ACT-S methodology is divided into several sector-specific methods, for which the objectives of GHG emission reductions and changes in the economy are taken from the SBTi's Sectoral Decarbonisation Approach (SDA) (see chapter 1.2.1). The term "science-based" – here associated to CCMTs – is given when they are independently assessed and verified to be in line with the sub-2 degrees global warming trajectory. However, this last criterion is rather hard to assess. If ACT-S considers that all companies are equal and should all reduce their GHG emissions with the same approach (regardless of their size, location or activity's social impacts), it is more complicated in reality. Indeed, there are several parameters to be taken into account when it comes to the compatibility of a company's targets with RCP pathways. For example, we need to integrate the notion of climate and distributive justice for this assessment: there needs to be equity between companies when it comes to climate change mitigation, as companies do not start from the same point and do not have the same means to implement an action plan. Additionally, the effects of competitive markets on the evolution of the sectors and their carbon performances are hard to predict, making the alignment of targets with +1.5°C or +2°C trajectories even harder to assess. This can be a limitation to the sufficiency of individual corporate CCMTs to contain global warming well below Paris Agreement limits.

2.3.7. Step 4B: Strategic plan

For this step, the ACT-S methodology relies on the Blue Ocean method, which is a strategic planning framework aimed at helping organisations to perform better in the market, by offering unique and quality value propositions to their customers. For this method, companies list actions in four different strategic pillars: *Eliminate*, *Raise*, *Reduce* and *Create*. Then, each measure will be coloured according to the category it is linked to: *material investments, immaterial investments, products and services, management, supplier engagement, client engagement, policy engagement and business model*.

This method has proved to be efficient for strategic planning and is widely used for companies' business strategies. Here, it has been adapted to climate change mitigation strategies by ACT-S to best fit the methodology and the *Strategy Toolbox*.

2.4. Compliance of ACT-S with the CCMS definition and criteria

After having studied the different elements of the ACT-S methodology for target setting and strategy elaboration, we will now take a look at the compliance of this method with the different criteria mentioned before, related to the performance of CCMSs and their alignment with a +2°C trajectory. As I said, we will take Abeysinghe's criteria as a basis for this assessment (Abeysinghe, n.d.) (see Section 1.1.3).

2.4.1. C1. Address long-term vision and mention actionable policy options, that is give concrete solutions to reduce GHG emissions, generally with a 2050-time horizon.

As far as criterion 1 is concerned, we want to know if the CCMSs elaborated with ACT-S would indeed address the climate change problem in the long-term, i.e., set long-term targets and have associated measures to reach them.

As we have seen before, the SDA, document on which the ACT-S methodology is based, describes a long-term vision of the low carbon transition by sector, until 2050. Therefore, a target fully[17] determined with ACT-S would indeed describe the long-term vision of the company, ideally with a 2030-to-2050-time scope. Moreover, the ACT-S methodology and the associated suite allow companies to evaluate which concrete measures they could and should put in place in order to reach the priorly set objectives. First, the tools help companies determine which emission categories they should focus on in priority, and then with the potential help of an external consultant, list some future policies the company should action to reach the targets. Furthermore, the theoretical carbon emission reduction potentials shall be calculated to testify that, in the end, these measures are at least sufficient to meet the trajectory set priorly. Again, this assumes that the company would carry out a full ACT-S project.

Therefore, this criterion is met by the ACT-S methodology.

2.4.2. C2. Involve company's managers and executives in its development process, who have an overview on the feasibility of some actions and previous experience in elaboration of strategy.

As we have seen before when describing the ACT-S methodology, the first step of the process is to form a workgroup responsible for the elaboration of the future CCMS. During all the different steps of the ACT-S process, various actors are involved, as can be seen in the following table:

[17] Here by "fully" I mean a target set completely with ACT-S, using all the recommendations, data, and tools available.

ACTION	BOARD	SPONSOR	COORDINATOR (+ ADVISOR)	TEAM MEMBERS	RESOURCE PERSONS	ALL EMPLOYEES	STAKEHOLDERS
1A. COMPANY PROFILE			X				
1B. MATURITY OF DECARB. STRATEGY			X	X	(X)		
2A. CARB. PERF. METRICS			X				
2B. CARB. PERF. ASSESSMENT			X		X		
2C. STRATEGIC ANALYSIS		X	X	X	(X)		(X)
2D. BOARD TRAINING	X	X	X				
3A. LONG-TERM VISION	X	X	X	(X)	(X)		
3B. TRANSITION ROADMAP	X	X	X	(X)	(X)		
3C. BOARD ENGAGEMENT	X	X	X				
4A. CARB. PERF. TARGETS		X	X	X			
4B. STRATEGIC PLAN	(X)	X	X	X	(X)		
4C. BOARD COMMITMENT	X	X	X				
5A. ACTION PLAN DEFINITION			X	X	X	(X)	(X)
5B. ACTION PLAN IMPLEMENTATION						X	(X)
5C. ACTION PLAN MONITORING			X	X			

Table 2.1. Actors involved in the respective actions throughout the ACT-S process (ADEME, 2021)

As can be seen above, for most of the steps, the coordinator is involved, but also the board and the sponsor. These actors are, for the most part, managers, or members of the company's board, therefore ensuring that the strategy is validated by top executives of the company and that its application will be possible afterwards. Indeed, as we have seen in Figure 2.4, the sponsor has to be a member of the board of directors, and other members of the ACT-S team should represent the main functions of the organisation.

Additionally, as mentioned in the chapter 1.3, every member of the ACT-S project should, prior to beginning of the concrete CCMS elaboration process, be trained on climate change and CCMS establishment topics, via the initial formation on ACT-S (presentation provided by the CDP and/or the external consultant), potentially completed by a Climate Fresk[18]. Completed by the personal knowledge

[18] See footnote 10.

of the members on company management, business and activities, the latter should be capable of evaluating the feasibility of each measure.

Thus, this criterion is met by ACT-S.

2.4.3. C3. Allocate responsibilities (in terms of emissions and action) between the different stakeholders.

The responsibilities in terms of emissions have to be made with the analysis of the GHG inventory of the company (and the partitioning between the different emission categories): each emission category can correspond to a stakeholder or a group of stakeholders (clients and fuel suppliers for *Use of sold products*, material suppliers for *Purchase of products or services*, energy suppliers for *Indirect emissions related to the consumption of energy*, …).

Then, indirectly, the actions related to one (or more) emission category can be linked to the stakeholder responsible for these GHG emissions. Additionally, within the *Strategy Toolbox*, the ACT-S suite offers a possibility to precisely describe each action and list the potential stakeholders involved. Thus, the more precise the company is when carrying out an ACT-S procedure, the more likely it is to clearly identify and allocation responsibilities between the stakeholders in terms of emissions and actions. This precision is also appreciated in the involvement of these stakeholders and facilitates the organisation of consultations with them.

We can consider that this criterion is met by the ACT-S methodology.

2.4.4. C4. Be coordinated by an overseeing institutional authority.

The question of an overseeing public authority has been brought previously when dealing with the Urban LEDS initiative. To this date, strictly speaking, the CCMSs that are set with ACT-S are not coordinated by a single institutional authority. Effectively, if the CDP and the ADEME, with ACT-A, allow a scoring system for CCMSs and therefore a potential comparison between them, they do not have the power to validate or invalidate a strategy: their role is only to point out their quality or the gaps they bear. This grading institution position can negatively impact the fight against climate change, as some companies may be misled for the elaboration and application of their strategies. However, the race for performance and highest scores between competing companies will likely lead the latter to develop quality CCMSs. Furthermore, with the ACT-S progress recognition system, the ACT Initiative started to oversee companies' advancements in the CCMS building process with ACT-S. However, as I mentioned before, the role of this programme today is only to check the advancement of companies in the process and the different titles granted by it do not take into account the quality of the elaborated strategy.

Still, the absence of an overseeing authority is regretted, as it would allow both avoid deceiving CCMSs (we can imagine that such an entity would evaluate their credibility and performance) and provide precise and thorough advice and feedback to companies, based on a solid comprehension of CCMSs and based on previous experience. Indeed, as we have seen with Urban LEDS, experience-based initiatives allow efficient recommendations and lead to concordance between companies' CCMS within the same sector. If the ACT Initiative indeed wants to develop such a program (CDP, 2021), it has not been done yet. Hence, we can say that the creation of such an overseeing institutional authority, or the development of the ACT-S progress recognition system and its extension in CCMS elaboration and validation, would be appreciated.

Therefore, this criterion is only partially met by ACT-S. The latter would have to be improved by creating an overseeing public institution aimed at (in)validating the strategies elaborated with ACT-S and advising companies for their ACT-S projects based on previous experiences. Unfortunately, the creation of such institutional authority lies on the fact that ACT-S would become a standardised method widely spread or even preferred when it comes to CCMSs' establishment.

2.4.5. C5. Designate a leader of technical work and operationalisation of the LTCS.

Within the ACT-S project teams, as we have studied before with Figure 2.4 and Table 2.1, a coordinator is designated to lead the process of elaboration and application of the CCMS. The latter, who can be helped by an external consultant – playing the role of an advisor –, is responsible of the technical steps of the establishment of a CCMS (which correspond to the steps 4 to 12 of the chapter 1.3[19]). The ACT-S methodology goes even further than this criterion, by stating that this person should be a member of the company's board of directors, to have an influence on the decisions and better insight on the functioning of the company, its management, and its strategy.

This criterion is met by ACT-S.

2.4.6. C6. Involve all the relevant departments of the company under study, to avoid competing or overriding policies.

When it comes to involving all the different departments of a company, ACT-S seems to perform well, as it is open to a possibility to involve at least one person from each section in the ACT-S workgroup, but it is not mandatory. Yet, it is stated in the methodology that this workgroup should involve the different departments when it comes to strategic planning. Indeed, the workgroup should engage discussions with the latter for the elaboration of concrete measures and policies for the company to take in or throughout the years to come. Anyway, this step appears to be quite natural in decision making and strategic planning as the measures are mostly taken internally and as the board has a high interest in satisfying all the employees and managers within its teams to guarantee a good functioning of the company.

Hence, the ACT-S methodology also meets this criterion.

2.4.7. C7. Be inclusive and transparent to the public, by involving citizens, suppliers and clients in the discussion processes and by assessing the impacts of potential measures on other aspects of the society and/or businesses.

Finally, as far as the involvement of external parties is concerned, the ACT-S performance seems to be limited. Indeed, if the process encourages (or even obliges) companies to involve stakeholders such as suppliers or economic partners through discussions on the future of their activities, this does not seem to be the case for the public. With the current recommendations and steps of ACT-S, clients' consultation is not mandatory, while the latter will – directly or indirectly – be impacted by the CCMS (changes in terms of offer, prices, efficiencies of the products, etc.). This is also the case for citizens in general, who

[19] Steps 9 and 10 being excluded or not depending on the considerations and scope of the strategy under study.

are not involved in the processes of strategic planning[20]. Yet, discussions with such external parties could be interesting because the latter:

- can have a different perspective on how the company could and/or should evolve (based on their own needs and the needs of the society)
- can directly be impacted locally by the measures taken by the company: attractivity of the territory because of employment, consumption of natural resources nearby (especially water), local pollutions, etc.

Hence, organising public consultations concerning – at least part of – the company's CCMS seems to be a good idea for inclusion and transparency to the public. Another limitation to the public's inclusion is that no direct access to the tool is available: companies either have to get access to it thanks to consultants or have to make a request to the ADEME and the CDP[21].

On the other hand, ACT-S, along with the TCFD's framework, encourages companies to disclose their current carbon performance and their transition plan, contributing to good transparency to the public.

Overall, this criterion is not entirely fulfilled by the ACT-S methodology: the involvement of the public must be improved, by organising public consultations, at least for the elaboration of concrete measures to reach the CCMTs, and the tools – for which there is currently no public access – could be available for everyone without request.

2.4.8. Overview and complementary criteria

To sum up what has just been seen, I gathered the 7 criteria given by Abeysinghe and the associated compliance of ACT-S to them in the following table:

Criterion	Compliance of ACT-S
C1. Address long-term vision and mention actionable policy options, that is give concrete solutions to reduce GHG emissions, generally with a 2050-time horizon	YES
C2. Involve company's managers and executives in its development process, who have an overview on the feasibility of some actions and previous experience in elaboration of strategy	YES
C3. Allocate responsibilities (in terms of emissions and action) between the different stakeholders	YES
C4. Be coordinated by an overseeing institutional authority	TO BE IMPROVED
C5. Designate a leader of technical work and operationalisation of the LTCS	YES
C6. Involve all the relevant departments of the company under study, to avoid competing or overriding policies	YES
C7. Be inclusive and transparent to the public, by involving citizens, suppliers and clients in the discussion processes and by assessing the impacts of potential measures on other aspects of the society and/or businesses	TO BE IMPROVED

Table 2.2. Compliance of ACT-S methodology with Abeysinghe's criteria on CCMSs

[20] However, note that public consultations have been carried out during the elaboration of the ACT-S methodology: both companies, politicians, and citizens were able to share their opinion.
[21] Although tools licenses are free if not for commercial use (internal implementation).

Regarding the TCFD's criteria on CCMTs are concerned, ACT-S performs well, as it respects all of them:

Criterion	Compliance of ACT-S
C8. Aligned with strategy and risk management goals.	YES
C9. Linked to relevant metrics: *in order to measure and track progress over time and assist with periodic reviews*.	YES
C10. Quantified and measurable.	YES
C11. Clearly specified over time: *targets should include a baseline, a time horizon, and interim targets (with for example 5 to 10 years intervals)*.	YES
C12. Understandable and contextualised.	YES
C13. Periodically reviewed and updated: *companies should have a clear process for reviewing climate targets, at least every 5 years*.	YES
C14. Reported annually (at least)	YES

Table 2.3. Compliance of ACT-S methodology with the TCFD's criteria on CCMTs

Indeed, with the structure of ACT-S's steps, targets should be set according to the vision and roadmap of the company, based on their strategic analysis and the context of the company, therefore it complies with C8 and C12. Additionally, ACT-S methodology requires the elaboration of adapted metrics for CCMTs, and the latter should be measurable. Hence C9 and C10 are respected. As far as C11 is concerned, ACT-S states that both short, intermediate and long-term should be covered by the CCMT. Thus, ACT-S complies with this criterion. Finally, the CCMS built by the company with ACT-S should be reviewed at least every 5 years, so C13 is met, and ACT-S follows the TCFD's recommendations for the disclosure of GHG inventories. Therefore, the last criterion is complied with by this methodology.

2.5. Gaps of the methodology and recommendations

We have seen previously that the ACT-S methodology and its various components were useful in the corporate CCMS elaboration, as it was meeting most of the requirements proposed by Abeysinghe for having good LTCS. However, this method and its tools are not perfect, and some drawbacks and gaps could be pinpointed. This chapter's purpose will be to highlight the elements of ACT-S I considered to have potential adverse effects on the quality of the CCMSs established with it.

2.5.1. Limitations related with the IEA's 2DS and/or the SBTi's SDA

First, as I started to partially mention previously, the documents and methods on which ACT-S is based bear drawbacks, which are thus also found in the latter. Indeed, a first element that could be underlined is the lack of dynamism of all the reports and their data in the ACT-S methodology. Effectively, the 2023's version of ACT-S takes its information from the SDA, which was published in May 2015. Despite the promise of being updated every 5 years by the SBTi, no other version has been released since this first date. The later gathering data, calculations and recommendations from the IEA's 2014 Energy and Technology Perspective, these elements may be inaccurate or even contradictory with the current

knowledge in climate change mitigation[22]. For example, while the GDP growth projections between 2010 and 2020 was of +4.0%/y (SBTi, 2015), it was of +2.6% in reality (World Bank Open Data, n.d.)[23].

Moreover, as I mentioned previously, the elaboration of sectoral strategies and targets fitting the RCP2.6 pathway rely on political choices. Indeed, despite the fact that the IEA and the SBTi are autonomous organisations, their recommendations and calculations are not politically neutral. For example, the distribution of the overall remaining carbon budget is a result of a series of choices, leading to expected cumulative CO_2 emissions about equal to this budget. We can then wonder if another choice could have been possible, notably considering decreasing activity levels for some sectors (e.g., aviation passenger transport or light-duty road passenger transport) or with lower growth rates (e.g., chemicals and petrochemicals), or if we could have set targets allowing total cumulative emissions lower than the remaining budget, leading to lower risk of reaching a +2°C global warming. Effectively, global warming levels are not discontinuous: nowadays, we consider too often that if the +1.5°C target cannot be reached, the next objective we should aim for is +2°C, whereas every tenth or even hundredth of a degree contributes to the perturbation of the climate and of ecosystems. In the article form Tilsted et al., dating from 2023, the fact that the SBTi is built on a limited set of possible scientific knowledges is deplored and said to narrow the possibilities of decarbonised futures (Tilsted et al., 2023). To this extent, other scenarios could have been studied, for example based on more sobriety, as the IPCC's WGIII recommended in the 6th Assessment report (IPCC, 2022). I also think that sectoral carbon budgets should not be based on overall carbon budgets but only on what can be technically, socially, and economically achieved. This statement echoes the previous ones: if the sectoral carbon budgets rely on the remaining GHG budgets, the risk is to allow unnecessary additional emissions, that we could have avoided by considering the sector on its own.

This limitation can be depicted by the following figure, showing that other potential scenarios and scientific works are not considered by the SBTi, leading to reduced vision on possibilities of transitions:

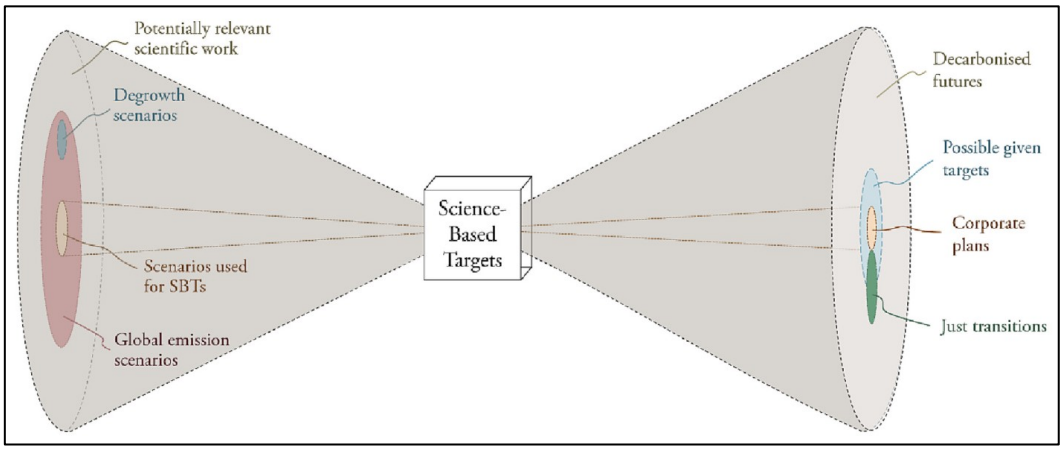

Figure 2.7. Representation of SBTi's "narrowing" of scenarios and associated futures (Tilsted et al., 2023)

Additionally, the scope of study of the SDA and the IEA's ETP is too narrow, as it is limited to CO_2 emissions. Indeed, if the non-CO_2 radiative forcings have been considered by the calculations, there is

[22] The IEA updates its Energy and Technology Perspectives report every 3 years (the latest version dating from January 2023).
[23] **NB:** The same divergence between ex-projections and observations can be highlighted for GHG emissions.

no specific recommendations for target setting or strategy establishment for the other GHGs than CO_2. Yet, the latter are quite important in some sectors such as chemical industry, agriculture and agrifood or waste management. Furthermore, the land use related emissions are not counted nor considered by the SDA, while they are said to account for 10% of the remaining budget (up to 2050) consistent with the RCP2.6 pathway (SBTi, 2015). The justification for this absence of consideration is given by the fact that "land use change is not attributed to any company". This statement can easily be criticised, as companies' activities can directly contribute to land use change (in the case of constructions or exploitations for example). Therefore, the latter could be held responsible for the associated GHG emissions, and at least part of the land use change emissions could be counted in the targets of the SDA. In the current version of the SDA, the lack of its consideration would result in an overshoot of the remaining GHG budget (1,055 tCO_2, as opposed to the 1,010 $GtCO_2$ calculated by the IPCC in 2014). It is considered acceptable because the target cumulative emissions would still be inside the 66% confidence interval of the +2°C aligned pathway (510 $GtCO_2$ to 1,505 $GtCO_2$). The problem of this consideration here is the same as before: we allow unnecessary emissions with this simplification, leading to increased risk of climate perturbation and augmentation of the occurrence frequency of natural disasters[24]. This overshoot is also said to be compensated by negative CO_2 emissions (thanks to "scaled-up technologies" like carbon capture) (SBTi, 2015), but the latter have not been quantified, and the impact of the development of these technologies on energy demand and GHG emissions either. Hence, we can question the pertinence of "betting" the alignment of companies' strategies to the RCP2.6 on technologies currently poorly developed and economically not viable.

Similarly to the previous argument, the fact that sector specific targets and recommendations have not been set/made for some sectors can lead to misleading or imprecise results. As a matter of fact, the "Generic" methodology of ACT, based on the SDA's namesake sector, includes a wide range of activities:

- Extraction activities
- Some industries (manufacturing, wholesale and repair of vehicles, infrastructure construction)
- Waste and water management
- Services with high GHG impact (financial and insurance activities, accommodation and food services, information and communication, human health and social work, arts, entertainment, and recreation)
- Services with low GHG impact (education, professional scientific and technical activities, administration and support, public administration and defence, compulsory social security, activities of households as employers, extraterritorial and other services)

These sectors and sub-sectors have been gathered in a single "Generic" category because of the reason exposed in the part 2.2: these sectors are, for the most part, heterogeneous and therefore it is hard to make recommendations or calculate carbon intensity targets. However, for some sectors such as information technology or industry, GHG emissions are quite important and so is their growth. Therefore, it would be interesting to develop sector-specific methods for them. This would require an important amount of work as the sectors might have to be broken down to several homogeneous sub-sectors, to be able to set sector-specific carbon intensity targets. The SBTi is conscious of this issue and is currently developing new sector specific methods.

[24] With the same way of thinking, one could wonder why the lower boundary of the confidence interval has not been considered a good target for the IEA and the SBTi, because it would also be 2-degree-aligned.

The SDA also lacks adaptability and precision in CCMT setting, as the method does not take into account the specificities of each company, and especially their current carbon performance: if a company has a high carbon intensity, the reductions it will have to reach will be higher than for a better performing one, but in the end there could be a high difference in terms of cumulative emissions over time. Indeed, the company which has the current lowest impact on climate change would be allowed to "pollute" less than the one with the highest impact. This injustice underlines the limit of having a common benchmark for all companies to follow, as the "right to pollute" is not pertinent at a corporate level, and the SBTi must take into account fairness principles to distribute mitigation efforts (Tilsted et al., 2023). Moreover, this lack of precision can also be found in the definition of the base year for the establishment. As a matter of fact, there is an ambiguity when it comes to defining the base year: the SBTi recommends setting it as the first year for which the company has realised a full GHG inventory, but this year can vary a lot between companies, and also if they change their method of counting GHG emissions over the years. This rule also ignores potential external effects on the company's GHG emissions for one or more years, such as the COVID-19 pandemic, which drastically reduced temporarily companies' emissions.

On another note, the SDA relies on an important assumption, which states that the economic growth (and GDP) is decoupled from CO_2 emissions arising from the use of energy and materials (assumption A3). However, if this is true for high values of CO_2 emissions (they are not proportional to GDP anymore), this may not be the case after a contraction of GHG emissions. Indeed, if the two indicators are indeed not proportional anymore (Haberl et al., 2020), stating that they are entirely decoupled seems quite optimistic: an infinite growth of the GDP would necessarily result in an increase of GHG emissions. Hence, this assumption can be considered quite simplistic (Parrique et al., 2019): we need absolute and total decoupling (Carbone 4, 2021).

Finally, apart from the technical assumptions and choices that have been made to set the sectoral CO_2 targets and produce recommendations for corporate CCMSs, the SBTi pinpointed a drawback for its SDA: the latter "does not take into account considerations of equity and fairness across different countries". For this topic, the problem is not to have emission goals which would lead to a sub-2-degree global warming level in 2100, but that the allocation of the responsibility for the mitigation of climate change is unfair for some countries and companies (Tilsted et al., 2023). Indeed, as the SDA is a method supposed to be applicable at a global scale, it does not consider differences in terms of means (in terms of money, workforce, training, and natural resources) for the elaboration and application of CCMSs. This can lead to additional inequity around the world, as countries with high means could indeed afford a low carbon transition, while poor and emerging countries would struggle for the same action (and potentially pay fines and/or taxes for not meeting the emission requirements set at an international level). Therefore, other allocation principles could be studied to make the distribution of mitigation efforts fairer and more ethical (Hjalsted et al., 2020).

2.5.2. Critic about ACT-S and its tools

As far as ACT-S itself is concerned, as I mentioned before, there is a lack of dynamism in the updating of data and targets. Indeed, the suite, released in 2019, is still based on the 2015 SDA's sectoral targets, while new targets have been calculated by the SBTi for some sectors. For the case studies, I had to manually add these numbers to set appropriate targets for the two companies.

In addition, I found that the tools for the establishment and validation of CCMTs could be improved. Indeed, I had to create my own calculation and visualisation tools to complete the ones available in the ACT-S suite (in particular in the *Carbon Performance* toolbox), because the graphs would not allow a

superposition of trajectories and a good comparison between companies' scenarios and the different benchmarks. Moreover, as far as the benchmark calculation is concerned, I found the tool inefficient, as it would only allow the generation of linear trajectories, therefore leading to higher cumulative emissions than curved trajectories (as a geometric sequence for example). I explained this issue in parts 3.1.2 and 3.2.2.

Furthermore, the ACT-S methodology seems to bring quite little help when it comes to calculating how much measures would cost. This echoes the last point of the previous part, about equity and economic feasibility of the application of corporate climate change mitigation measures. For a company to evaluate the pertinence of writing a certain action in its CCMS, it is important that the company assesses if this measure could indeed result in efficient GHG emissions cuttings, but also if the company currently has – or can possibly have in the future – the required means (workforce, financial, time, …) to put it in application. The *Strategy Toolbox* tool from the ACT-S suite offers basic help with questions the company should ask itself, but without the help of a climate change expert (who can be for example an internal or external consultant, trained on these topics), this task appears to be quite difficult. Hence, additional help for this step would be appreciated.

2.5.3. Other limitations

Further gaps related to the ACT-S methodology as a means to elaborate corporate CCMSs can be identified. Effectively, if ACT-S is performing well to assist companies in the reduction of their impact on climate (possibly with a reduction of energy consumptions and waste generation), this statement cannot be extended to other planet boundaries. As a matter of fact, ACT is exclusively focused on one planet boundary (climate change), and the other ones are unfortunately not covered by this initiative. This could be a problem, because companies do not necessarily have a sufficient overview on these other impacts and challenges. Therefore, the risk here would be that by implementing measures in their CCMSs to address climate change, companies may defer negative impacts to other categories. For example, the choice of the source of raw materials may reduce the overall carbon impact of the company's activity, but it might also cause adverse effects on the environment (e.g., higher water consumption, potentially in water scarce regions, higher use of chemicals, …). If today these impacts are not quantified (nor considered) by the methodology, it is still important for companies to keep in mind that such problem referrals should be avoided. To do so, the methodology could be upgraded to a version where the following planet boundaries would be taken into account:

- Atmospheric aerosol loading
- Freshwater use
- Stratospheric ozone depletion
- Biogeochemical flows
- Land-system change
- Novel entities

The latter are the ones best understood by science, and the ones for which the quantification of causes and/or impacts is the easiest (the methods are well developed). Even if not implemented with the same level of precision as climate change impacts, to my opinion these other planet boundaries should not be ignored in the elaboration of CCMSs.

Lastly, as I mentioned in chapter 2.3.4, ACT-S nowadays lacks an overseeing institutional authority, which would be responsible for the validation of CCMSs and providing help and feedback to companies. The goal for this institution would be twofold. First, it would become easier for companies to set their CCMTs and imagine efficient actions to reach them, thanks to the experience from other companies from the same sector. On the other hand, this would also help to avoid greenwashing: if some objectives or measures are unrealistic, inefficient, and/or only seem like a publicity stunt for the company, the authority could request the latter to modify its CCMS.

Also, to complement this coordination and control role, the authority could facilitate discussions between companies and public entities. Indeed, as mentioned before, we can highlight a lack of involvement of the public in the elaboration of CCMSs, but also of public administration (governments, regions, …). With the same basis as Urban LEDS, ACT-S would need an improvement of the implication of such third parties: the more diverse the opinions, the better the quality of the strategy.

2.5.4. Synthesis: overview and recommendations

To sum up what has been previously stated, I gathered the gaps priorly listed in the following table, along with the associated recommendations to close them:

Methodology or institution concerned	Gap	Recommendation
ACT-S, SBTi (with SDA)	Lack of dynamism in updating data, methodologies, and recommendations.	Stronger commitment to the update schedule (every 5 years at least).
IEA, SDA	Global and sectoral targets are derived from political choices. Recommendations are derived from sectoral budgets rather than an analysis of what would be socially, technically and economically feasible.	Future targets should not be derived from remaining budgets but from a feasibility point of view, to limit overshooting and "unnecessary" emissions.
SBTi	The scope of scenarios and relevant scientific work studied by the SBTi is too narrow, leading to limited possibilities of transition futures.	The SBTi should widen its range of sources get rid of some of its assumptions to prevent this narrowing.
SDA	Calculations on targets are only considering CO_2 emissions, and other GHGs are not subject to sector specific recommendations.	Some separate recommendations concerning CCMT setting should be given for sectors with high non-CO_2 emissions.
SDA	The SDA does not consider land use related emissions, but the later can be company-induced and therefore should be considered in CCMTs.	The SBTi should develop a method to calculate and set CCMTs related to land use emissions, for each sector.
SDA	The current strategy of the SDA allows a light overshooting of the remaining carbon budget, justified by a supposed development of carbon capture.	This overshooting should be removed as the development of carbon capture techniques and technologies is uncertain.
ACT-S	The current version of ACT-S lacks some sector specific methodologies.	Some new sectoral methodologies and recommendations should be developed.
SDA, ACT-S	As of today, the SBTi and ACT-S do not consider equity or social and climate	Equity should count in the setting of corporate CCMTs and therefore ACT-S

	justice factors for the calculation of CCMTs. The specificities linked to current carbon performances of companies are not considered.	should express some recommendations on this topic and how to treat differently intrinsically different companies.
IEA, SDA	The assumption of the decoupling of CO_2 and GDP can be misleading.	This assumption should be removed from the SDA's foundations.
ACT-S	ACT-S's toolboxes for CCMT setting are light in terms of pertinence for the visualisation of latter's efficiency.	Some new tables and graphs could be added to the *Carbon performance* toolbox.
SBTi, ACT-S	ACT-S only allows the study of linear benchmarks for target setting.	Some other types of curves could be added for trajectory setting, to minimise cumulative GHG emissions over time.
ACT-S	The method and tools are of little help to characterise measures in the action plan elaboration step.	Some techniques to efficiently carry out this step could be given in the initial ACT-S training (by sector).
ACT-S	Other planet boundaries are not studied nor mentioned by the methodology.	Some other planet boundaries could be added in the methodology to limit the deferral of negative impacts from climate change to others.
ACT-S	Lack of verification of CCMSs built with ACT-S, and no overseeing from an institutional authority.	Creation of a standard on CCMS elaboration (with ACT-S) and of an entity aimed at both controlling the quality of the latter and providing feedback to companies (based on success stories).

Table 2.4. Recapitulative list of ACT-S's gaps and associated recommendations

3. Case studies

After describing the theoretical elements of ACT-S and its potential limitations, in order to best understand how the ACT-S methodology and its tools work in concrete terms, we will carry out two case studies. For the latter, I chose the two companies in such way that I would be able to draw conclusions on various aspects. Indeed, these are the characteristics of the two companies studied:

CHARACTERISTIC	COMPANY 1	COMPANY 2
Sector *(Associated ACT-S sector)*	**Restoration (mass catering)** *Agriculture & Agrifood*	**Automotive** *Auto*
Geographical situation	**One country only** *(France)*	**International** *(Argentina, Brazil, Canada, China, France, Germany; India, Mexico, Romania, Russia, South Africa, Spain, Thailand, Türkiye, UK, USA, Venezuela & Vietnam)*
Type of activity	**Selling services** *Preparing meals for companies' and schools' restaurants*	**Selling products** *Manufacturing and selling light-duty vehicles and trucks*
Size	**633 FTE** *(in 2021)*	**172,762 FTE** *(in 2022)*
Annual revenue (*2022*)	**54.4 M€** *(≈ $59.2 M)*	**$158.1 B** *(≈ 145.2 B€)*
ACT-S project	**Real**	**Fictional**
GHG emissions *(2020)*	*Scope 1:* **1,015 tCO2e** *(2.4%)* *Scope 2:* **24 tCO2e** *(<1%)* *Scope 3:* **41,575 tCO2e** *(97.6%)*	*Scope 1:* **2.04 MtCO2e** *(0.6%)* *Scope 2:* **4.42 MtCO2e** *(1.2%)* *Scope 3:* **349.3 MtCO2e** *(98.2%)*

Table 3.1. Comparison of the characteristics of the companies used for the case studies

We can see here that the two companies are very different, both in terms of size, geographical scope, and activity. The idea behind this choice was to prove the adaptability of the method to a wide range of company, regardless of their specificities.

However, because of a lack of data and overview on the whole ACT-S projects, the case studies will mainly be focused on the step 4A, i.e., on CCMT setting. Indeed, the ACT-S project being carried out in one to three years, it was impossible for me to assist a company for their entire process. Yet, I still tried to understand the vision and action plan elaboration steps for the first case study to assess ACT-S's performance. Additionally, a limitation must be mentioned for the second case study: the second company had not carried out an ACT-S project, therefore this case study is fictional, but based on all the documents available to the public regarding the sustainability and business plans of the company. Obviously, these documents not being as complete as the list of information required to fill the different ACT-S tools, some hypotheses had to be taken. The latter, imagined to be in accordance with the company's current state or vision, will be mentioned throughout the case study. Hence, overall, the first case study will be more holistic as it covers all the steps of ACT-S, while the second one will be more focused on prospects of emissions and trajectories.

3.1. Company 1 – Restoration company in France

For the first company I chose, along with Nicolas Desmoitier, who accompanied me for the elaboration of this thesis, a mass catering company based in France, which worked with Toovalu for the reflexions on their future climate change mitigation strategy. This company, created in 1970, nowadays counts more than 600 full time employees, preparing and delivering more than 65,000 meals every day.

Within the scope of reducing the environmental – and more precisely climate – impact of its activity, the company carried out an ACT-S project with the help of Toovalu and another consulting company between 2021 and 2022. The team was composed of a sponsor, the company's co-director, a coordinator, responsible of the company's CSR, and other members like the purchasing director or the safety and environment coordinator. During these two years, this team went through all the steps of the ACT step-by-step methodology, from the quantification of carbon emissions to the formalisation of CCMTs along with concrete actions to be taken during the upcoming years.

For confidentiality reasons, the company and associated results are anonymised, so I will refer to it as Company 1 throughout this report.

3.1.1. Initial situation

To evaluate the initial commitment of Company 1 to reduce their GHG emissions and its understanding of the climate change issue, the ACT-S suite offers, in the *Progress Grid* tool, a series of questions aimed at scoring the progress of the company in the elaboration of their CCMS. For each question, several levels of maturity are possible: *basic*, *standard*, *advanced*, *next practice*, and *low-carbon transition aligned*. There are several questionnaires, for different steps of the ACT-S process: *Initial diagnostic*, *Issues and challenges*, *Vision*, *New strategy*, and *Action plan*. The latter can be both seen as a checklist to ensure that the company understood well the different levels of commitment possible for each step, but also as a scoring tool to evaluate its progress throughout the process. Initially, the company's commitment score had the following profile:

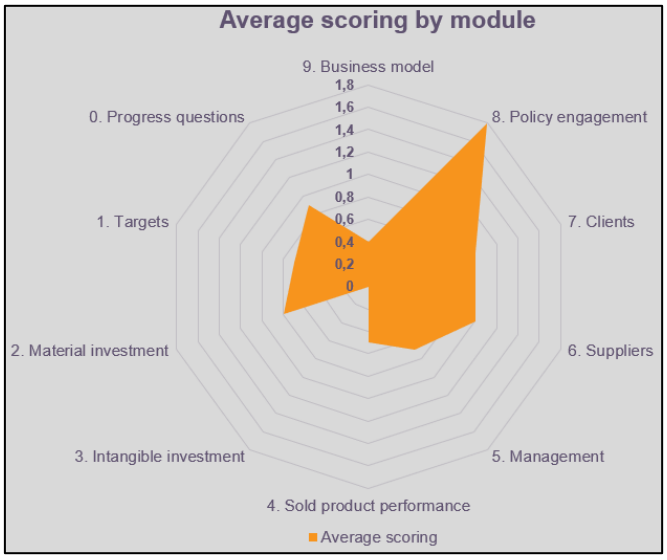

Figure 3.1. Initial maturity scoring of Company 1's CCMS.

For each criterion, the score is expressed as a number on a scale from 0 to 4. Therefore here, we can see that Company 1 was not very advanced at the beginning of the CCMS elaboration process (average maturity score of 0.8/4).

When it initiated its ACT-S process, the company had quantified its carbon emissions for scopes 1, 2 and 3 for the years 2018-2019 and 2019-2020. They were as follows:

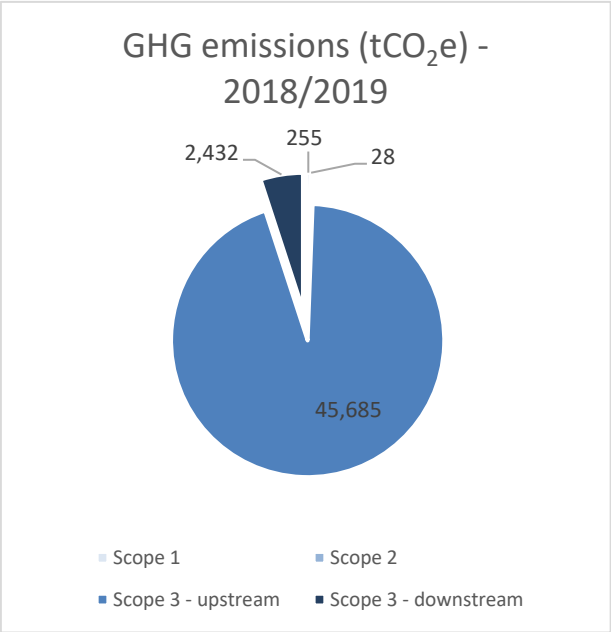

Figure 3.2a. GHG inventory of Company 1, 2018-2019

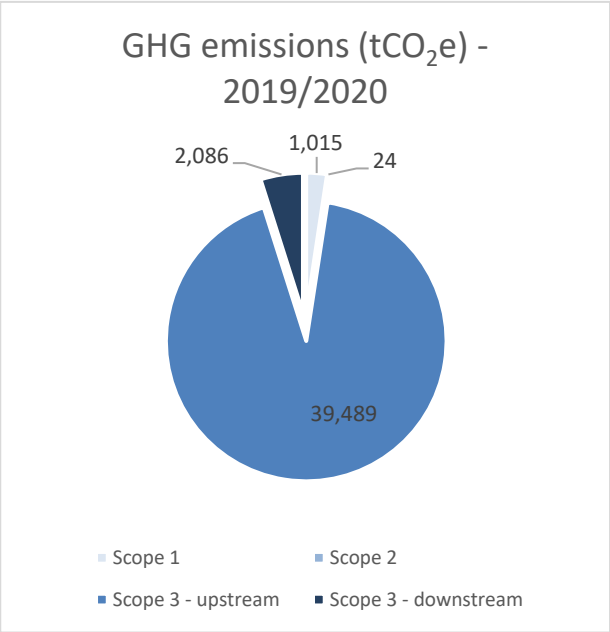

Figure 3.2b. GHG inventory of Company 1, 2019-2020

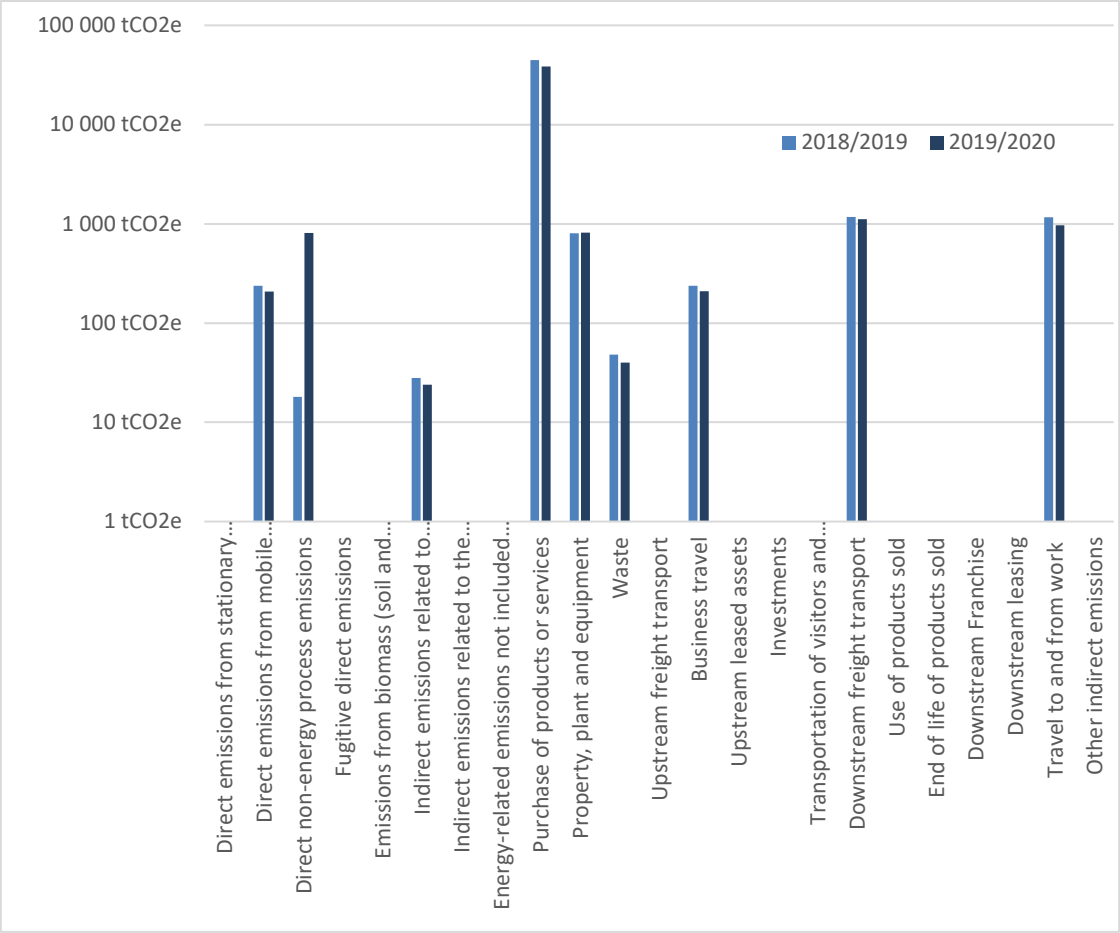

Figure 3.3. GHG inventory of Company 1 per year and emission category (log scale)

We can see here that GHG emissions from category 3 represent more than 91% of the total GHG emissions. Mostly, the emissions come from the categories "purchase of products or services" (*38,425 tCO_2e in 2020*), which corresponds to the purchases of raw materials (e.g., ingredients to prepare the meals), "downstream freight transport" (*1,117 tCO_2e in 2020*), which corresponds to the delivery of meals to the different canteens, and "travel to and from work" (*969 tCO_2e in 2020*), corresponding to the workers' commuting. As far as scope 1 is concerned, the emissions mainly come from the fuel consumption of the company's vehicle fleet and from the use of cooling systems (with uncontrolled emission of fluorinated gases). Scope 2 emissions depict the climate impact of the company's electricity consumption.

This first diagnostic tells us about the materiality of each emission category, and therefore where to put the focus when establishing the company's carbon transition plan. Here, the choice of products for the future meals sold will be of paramount importance for the reduction of upstream scope 3 GHG emissions. Then, several criteria have to be considered for this reduction: the type of products (vegetables, cereals, meat, …), their origin (local or imported), the means of production and transformation (did the process consume a lot of energy or emitted GHGs?), and the season. However, in order to understand which actions have to be taken, we need to know the levels of reduction of carbon needed to fit a 2°C (or even 1.5°C) trajectory. To do so, we will use the "Carbon performance" tool of the ACT-S suite.

3.1.2. GHG emissions reduction: benchmarks and company's targets

Before determining the different measures that the company can take in order to reduce its carbon emissions, we need to set quantified targets to be achieved, to avoid inefficient decision making related to this topic. It is indeed the idea behind the ACT and SBT initiatives: GHG trajectories have to be *science-based*, that is they have to be set according to realistic scenarios which lead to a sustainable – in terms of climate change here – world. To this extent, the ACT-S suite has a tool to calculate trajectories and compare them to benchmarks to evaluate their pertinence in tackling long-term climate change: the *Carbon performance* toolbox.

The latter has 7 calculation worksheets, in addition to 4 user guides and resources worksheets:
- **2.A Corporate general data**: *with data and calculations on the current and future overall and financial results of the company*.
- **2.A Corporate GHG data**: *with data and calculations regarding the current and future levels of GHG emissions of the company.*
- **2.A Locked-in assets**: *with data and calculations concerning assets for which there are locked-in emissions, that is to say emissions the company will not have a control on in the future. (not used here)*
- **2.A Locked-in use sold products**: *idem but with sold products' locked-in emissions. (not used here)*
- **4.A Target and benchmark**: *graphs to compare the GHG emissions trajectories imagined by the company (in the worksheet "Corporate GHG data") and the benchmarks (see next worksheets).*
- **SBT benchmark generator**: *Generator of absolute and relative emission contraction benchmarks, by adding the initial value (base year), the target year (2050 here) and the scenario considered, between 1.5°C ("WB2C"), 2°C and IEA's Sustainable Development Scenario ("SDS").*
- **Benchmark compilation**: *Compilation of benchmarks previously calculated (manually added) and other absolute and relative benchmarks, coming from sectoral ACT methodology (indicators, mostly of carbon intensity).*

First, the company has to enter current data concerning its activity (types of products sold, quantities sold, revenues, number of full-time employees, yearly passenger.km transport, …) in the worksheet "Corporate general data", for at least a base year. Then, the company can add or calculate previsions of future data, considering potential growth rates, economic variations, goals, etc. In our case, the company chose to study two different economic growth scenarios: one with no growth and one business-as-usual, with a constant 6% annual growth from 2022 to 2050 in terms of revenues (and 5% growth in terms of number of meals sold). These scenarios will allow calculations regarding the carbon intensity. For comparison and feasibility analysis purposes, I also added a 1.5% degrowth scenario (in terms of number of meals sold). The data coming from these scenarios has been summarised in the following table:

Scenario	Meals sold growth	Number of meals		
		2021	2030	2050
Business as usual	+5%	13.80 M	21.40 M	56.79 M
No growth	+0%	13.80 M	13.80 M	13.80 M
Degrowth	-1.5%	13.80 M	12.04 M	8.90 M

Table 3.2. Number of meals sold – comparison between the scenarios

3.1.2.1. Company 1's stated scenario

After completing this step with economic data and indicators, the company wants to take a look at its GHG emissions and evaluate targets compatible with a +1.5°C to +2°C global warming scenario. To do so, it has to input its current and past GHG emissions data, coming from its GHG inventories, in the worksheet "Corporate GHG data". Then, it can calculate future GHG emissions levels as it pleases it:

the template does not include pre-made formulas or models to apply, the company must add them manually. In the case of Company 1, they chose to set a percentage of reduction to be achieved between 2019, the base year, and 2050, the target year, and apply a linear reduction (constant annual reduction rate). This is the result for their objective of a 46% reduction[25]:

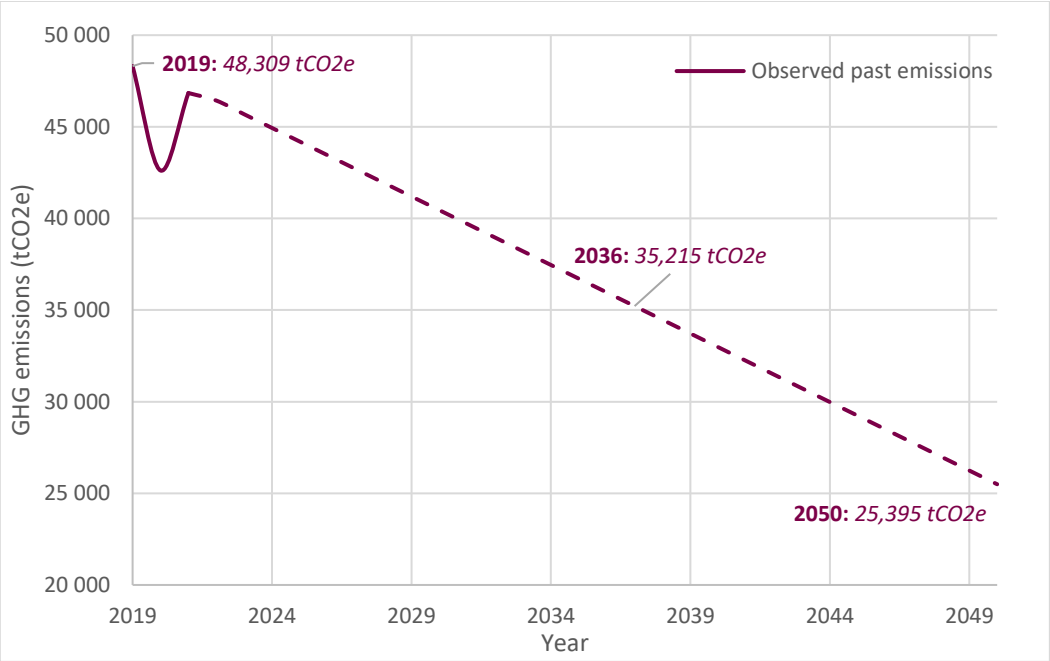

Figure 3.4. Evolution of GHG emissions (scopes 1, 2 and 3) for a 46% reduction scenario

We can observe an important drop in the company's GHG emissions in 2020: this is due to the influence of the COVID-19 pandemic on its activity. Indeed, this year, the number of meals that were sold was way lower than in 2019.

The scenario set by the company is linear, and so are the SBTi benchmarks. We can discuss the efficiency of such trajectories. Effectively, a non-linear scenario – corresponding to a geometric sequence – implies a stronger GHG emissions reduction during the first years of the transition plan than in the end. This trajectory bears two main assets, as compared to a linear one:
- it is more realistic, as contractions of the emissions are harder to achieve when the emissions' intensity is already low.
- it is more performant, as cumulative emissions (surface below the curve) are smaller than for a linear reduction fashion.

Here, the number -46% comes from the recommendations of the SBTi: -1.5% per year for a +2°C global warming scenario, for 31 years (2019 to 2050). Therefore, this reduction is compatible with a 2 degrees scenario. However, it is important to note that the SBTi's recommendations consider a linear reduction of GHG emissions over time, which would result in higher cumulative emissions. This point will be discussed later, with the comparison of the three scenarios with SBTi's benchmarks.

[25] Emissions from all scopes undergo equal contractions. As scope 3 accounts for more than 90% of overall GHG emissions, different contractions between the scopes would not be significative for the overall GHG emissions reduction.

3.1.2.2. *Comparison of the stated scenario with benchmarks – absolute emissions*

Once we have set emission targets for scopes 1, 2 and 3, we must compare this scenario with benchmarks generated with the worksheet "SBT benchmark generator". We will compare scenarios for all scopes together. Two benchmarks will be studied:

- A +2°C benchmark (SBTi): -1.23% per year.
- A "*Way below +2°C*" benchmark, corresponding to a +1.5°C scenario (SBTi): -2.50% per year.
- An added benchmark, corresponding to the Agriculture sectoral +1.5°C scenario of the SBTi: -3.03%/year.

Thanks to the benchmark generator, by inputting the initial GHG emissions of the company, we can generate target emission reductions following a linear fashion. Then, I compared them to the scenario previously mentioned. The results are presented in the following graph:

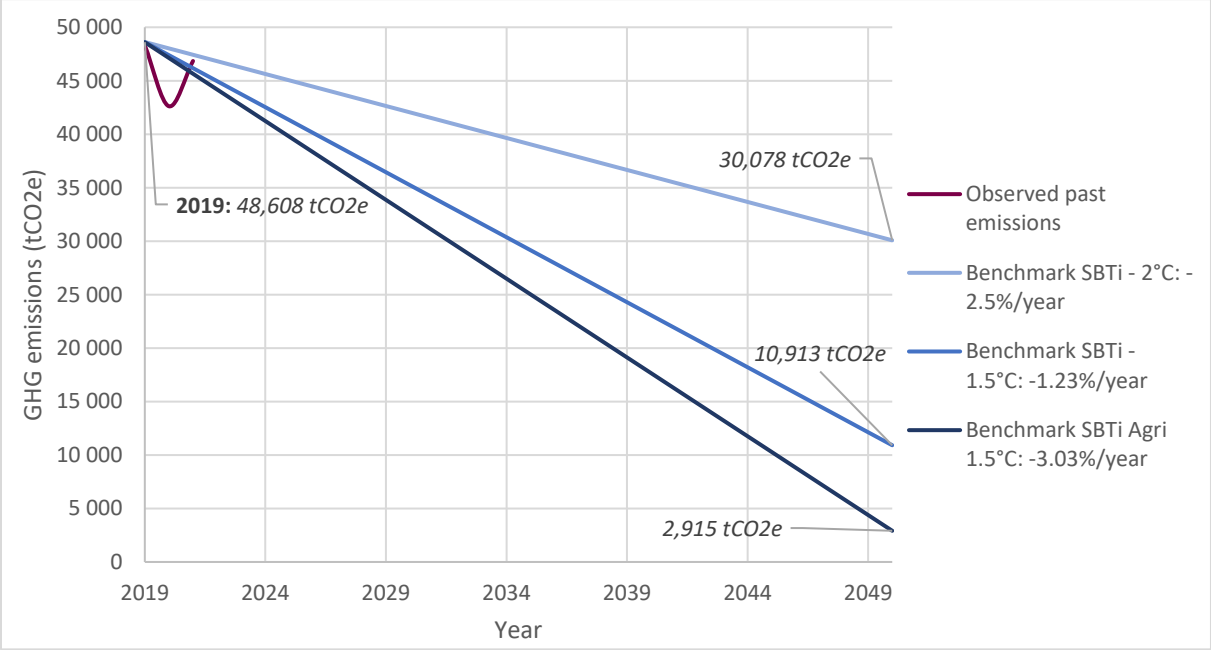

Figure 3.5. Comparison of the 46% reduction scenario with the three generated benchmarks

We can see that while this scenario is compatible with a +2°C global warming pathway, it is far from achieving the goals of a generic +1.5°C pathway: there is a 15,000 tCO2e gap between the two. The difference is even higher when we consider the sectoral +1.5°C pathway. Hence, I saw here the need to study more scenarios, which would allow to meet the emissions goals of each benchmark. Therefore, I created two more scenarios[26]:

- one with 38% reduction, whose value in 2050 corresponds to the one of the +2°C benchmark
- one with 78% reduction, whose value in 2050 corresponds to the one of the +1.5°C benchmark

[26] The sectoral SBTi benchmark being too far from the company's -46% scenario, I decided not to add another scenario in order to keep readable graphs. However, it would correspond to a -94% scenario, which is way more ambitious than the -46% target set by the company.

We can add these scenarios to the previous graph. The results are presented in the Figure 3.6:

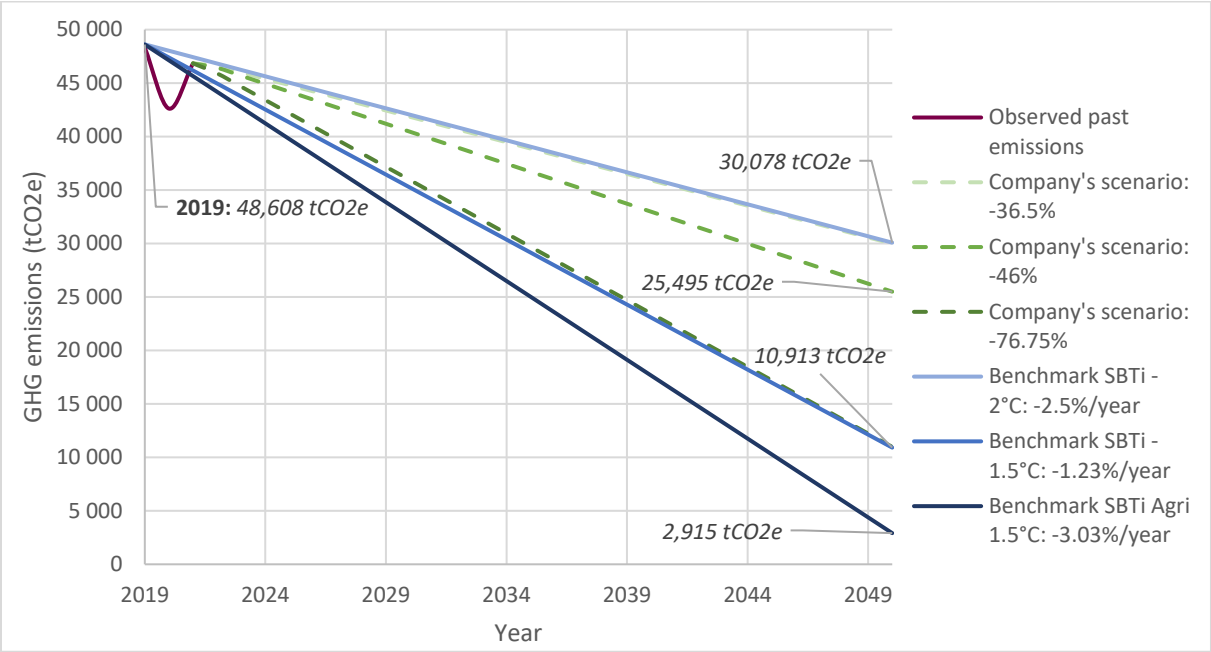

Figure 3.6. Comparison of different scenarios with the three generated benchmarks

We can see here that the 2050 target for the -36.5% scenario corresponds to the +2°C benchmark SBTi target, and the 2050 target for the -77.75% scenario corresponds to the +1.5°C benchmark SBTi target. However, as mentioned before, there is a difference in terms of cumulative emissions between benchmarks and the scenarios, as the latter are not linear. While this difference seems negligible for the +2°C compatible scenario, it is quite important for the +1.5°C compatible scenario. Indeed:

- For the first one (+2°C), we have a cumulative difference of about 28,000 tCO_2e between 2019 and 2050, which corresponds to a 2.4% increase in the total GHG emissions of the company's scenario.
- For the second one (+1.5°C), this cumulative difference is of about 146,000 tCO_2e, which corresponds to 18.9% increase in the total GHG emissions of the company's scenario.

This difference can be an issue in the way of determining CCMTs. To this extent, the SBTi's objectives are either unclear or do not allow the definition of efficient CCMSs. Hence, companies better set their target trajectories with non-linear reductions of their emissions (corresponding to relative annual reductions). One could argue that these target trajectories are harder or impossible to achieve for companies, but the latter encourages companies to prioritise the measures to be taken, in order to have efficient carbon emissions reductions in the short-term, and finish with less efficient measures. In addition, it is important, after defining such emissions trajectories, to assess the achievability of the targets thus determined. We will now carry out this assessment, by analysing the evolution of GHG emissions in terms of carbon intensity of products sold (relative GHG emissions targets).

3.1.2.3. Comparison of the stated scenario with benchmarks – carbon intensity

The relative emissions analysis combines the results of both company's economic data and GHG emissions evolutions: by dividing total emissions by the number of meals sold on the same year, we can create a carbon intensity indicator for the meals it will sell in the future, in $kgCO_2e$/meal. I calculated these indicators for the three economic scenarios (*business as usual*, *no growth*, and *degrowth*), and the three carbon emissions scenarios (*-36.5%*, *-46%*, *-77.75%*). Then, I went to the ADEME's emission factors' database to retrieve current emission factors for different types of meals: *average meal*, *vegetarian meal*, *meal with beef*, and *meal with chicken*. I then combined the results into three graphs, to analyse the reachability of the CCMTs previously determined:

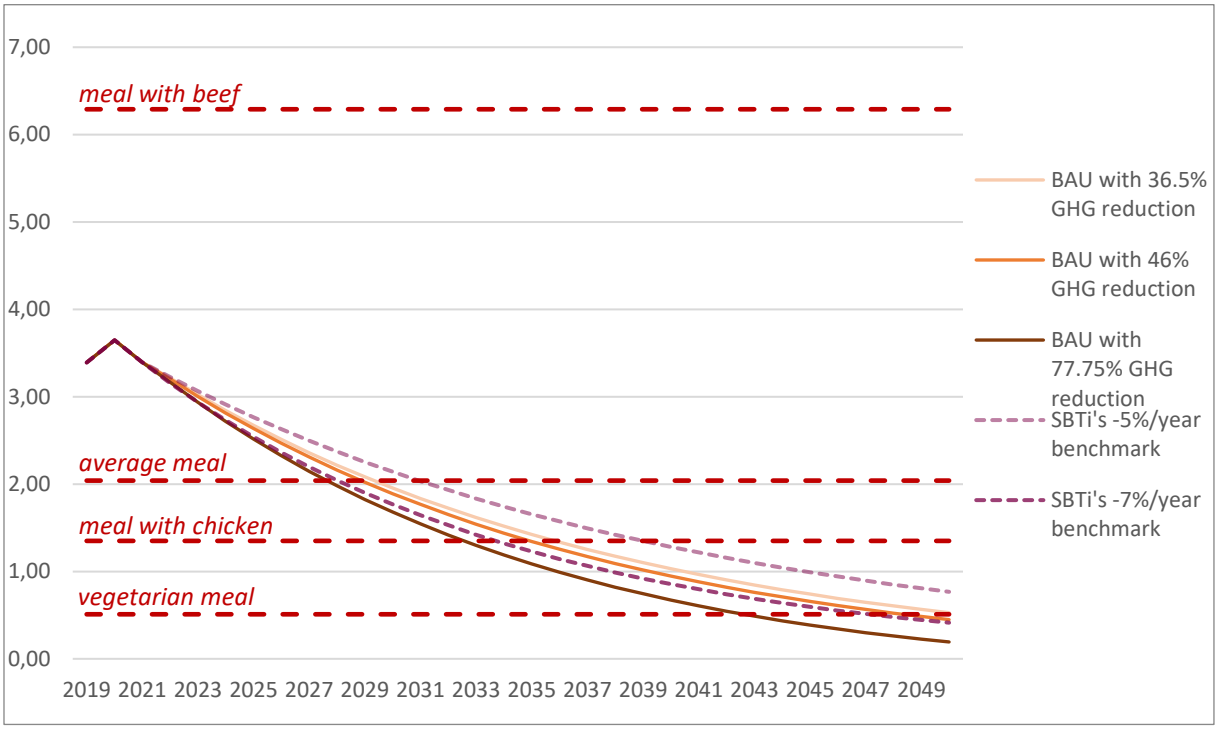

Figure 3.7a. Scenarios of evolution for meals' carbon intensities – Business as usual – $kgCO_2e$/meal

On the previous figure, we can first notice that the current carbon intensity of Company 1's sold meals is higher than the *average meal* emission factor retrieved from the ADEME's database (dating from 2017). This is partially due to the fact that, as opposed to the emission factor – which considers a meal that whose ingredients would be bought by a household and then prepared at home –, the indicator for the company also takes into account other GHG emissions, related to their activity (administration, workers' commuting, …). If we only consider the emissions of the "*purchase of products or services*" category, for the year 2020, we get a carbon intensity of 3.29 $kgCO_2e$/meal, instead of the 4.05 $kgCO_2e$/meal calculated here. A difference of 1.25 $kgCO_2e$/meal remains: this could be explained by the fact that the company choses more carbon emitting products for its meals.

After noting this difference, we can analyse the credibility of such scenarios and targets. As -38% and -46% curves are quite close for each graph, we will only analyse the -36.5% scenario as it embodies the targets for a +2°C trajectory.

• For the *business as usual (BAU)* scenario, we can see that in 2050, the carbon intensity of the meals sold by Company 1 will have to be the one of a vegetarian meal (of 2023) to be aligned with a +2°C trajectory. One could then ask if this is an actually reachable target or if, on the contrary, the latter is too ambitious. At first sight, it seems that this target of 0.51 $kgCO_2e$/meal is out of reach. Indeed, it seems unlikely that in 2050 sells only vegetarian meals to its clients, given nowadays' social acceptability of 100% vegetarian diets in canteens. Furthermore, we can express doubts about the possibility of all meals, including ones containing meat (and especially beef), to reach a carbon intensity of 0.5 $kgCO_2e$/meal.

As most of the emissions fall into the scope 3 category, knowing if the targets are reachable is more difficult than for scopes 1 and 2 as, by definition, the scope 3 concerns emissions related to the company but, for the most part, exogenous to it. Effectively, if some emissions like waste generated or employees' commuting are endogenous and require internal action by the company to be cut, most of the emissions of Company 1 (products and services purchased, end of life of products sold, …) are exogenous and therefore require external action to be reduced. However, we can still analyse the intensity trajectories by putting in parallel the targets under study to the ones related to the sectors concerned by the material emission categories (here mostly the agriculture and agrifood sector). Even with efforts being made in the agricultural sector to reduce the climate impact of its products (through measures like seasonal and local products only, with sustainable production methods, more efficient equipment, etc.), it seems unlikely that the emission factor of an average meal decreases from 2.04 $kgCO_2e$/meal to 0.51 $kgCO_2e$/meal. Since with animal farming there are some inevitable emissions, making such an important reduction in the carbon footprint of meals impossible to achieve. Indeed, Poore & Nemecek showed that at a global scale, the shift from an average current diet to a vegan diet would result in an about 48% decrease of GHG emissions of the meals (Poore & Nemecek, 2018). Furthermore, they have shown that the change in agricultural practices could lead to significant cuts in GHG emissions (up to about 30-40% for temporary and permanent crops and to about 50%-60% for animal products), but these results vary quite a lot depending on the geographical situation. Hence, by combining these results, we can expect, provided that important efforts are made in the agricultural and agrifood sector, GHG emissions cuts of up to 85% (vegan diet with important changes in agricultural practices). This would result in an emission factor of an average meal to about 0.33 $kgCO_2e$/meal, and a carbon intensity for Company 1 of about 0.54 $kgCO_2e$/meal. If this corresponds to the target of a SBTi's +1.5°C scenario for a business-as-usual growth trajectory, it is unlikely to be reached considering the commitments of the company ("increasing the number of vegetarian meals in the offer" and not "providing only vegan meals") and the requirements of such a cut in carbon intensity of meals.

Therefore, we can exclude the possibility for Company 1 of reaching a +1.5°C-aligned target in a BAU scenario. We can also exclude the -77.75% scenario from the credible ones. Therefore, we can note that if ACT-S is efficient for setting CCMTs aligned with SBTi's benchmarks, it does not provide organisations with information concerning the achievability of these targets in the first place: the later have to study the reachability of the generated targets. Nevertheless, it is important to note that the +1.5°C BAU scenario is aligned with a 7% annual reduction of the carbon intensity, recommended by the SBTi, so this scenario could still be desirable.

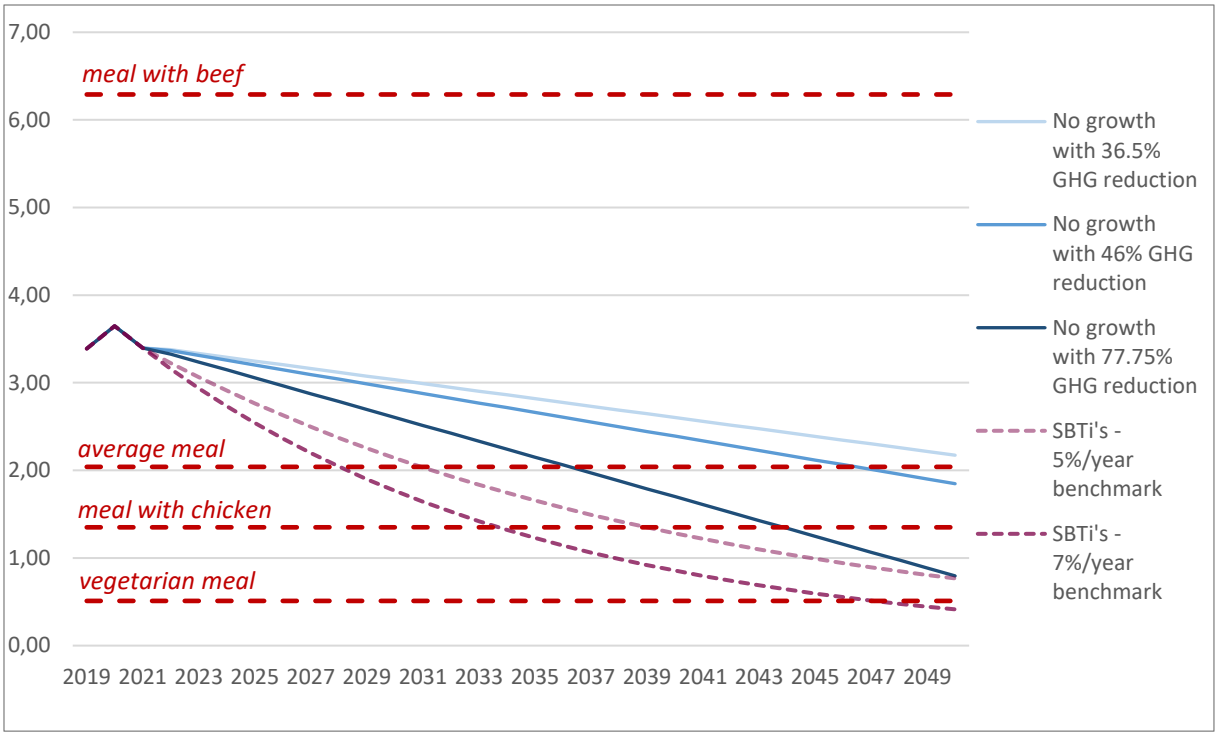

Figure 3.7b. Scenarios of evolution for meals' carbon intensities – No growth – kgCO_2e/meal

• As far as the *no growth* (NG) scenario is concerned, the 2050 targets seem more achievable. Indeed, they are close to current carbon intensity indicators' values for meals. For the -36.5% scenario, the carbon intensity to be achieved in 2050 is 2.17 kgCO_2e/meal, just above the current value of an average meal. Hence, the target seems more achievable. The -46% scenario also seems realistic, given the potential in emission cuts studied by Poore & Nemecek mentioned before, but the -77.75% scenario appears to be a bit too ambitious, as the target of 0.77 kgCO_2e/meal is similar to the target of the *business as usual* -38% scenario studied previously. However, the -77.75% NG scenario is aligned with a -5%/year carbon intensity scenario, and not ambitious enough for a -7%/year carbon intensity scenario, recommended by the SBTi.

Figure 3.7c. Scenarios of evolution for meals' carbon intensities – Degrowth – kgCO_2e/meal

• Finally, it seems that for the *degrowth* (DG) scenario, all three absolute GHG emissions reduction scenarios are feasible, as even for the -77.75% scenario, the carbon intensity to be reached in 2050 is 1.19 kgCO_2e/meal, which is just slightly inferior to the current emission factor of a meal with chicken. The targets are even easier to achieve when it comes to the -36.5% and -46% scenarios, as they require little to no reduction in meals' carbon intensity between 2019 and 2050. Yet, these 3 scenarios would not be considered ambitious enough regarding the carbon intensity decrease target set by the SBTi (-7%/year). Hence, these scenarios, while very attractive because relatively easy to reach, are not desirable for addressing the climate change issue efficiently.

To conclude, we can say that the company should maybe consider a new scenario with a lower growth rate in the meals they sell – maybe of +2% or +3% instead of +5% – in order to obtain +2°C- or 1.5°C-aligned targets that are achievable. However, it is important for Company 1 to keep in mind that it should reduce the carbon intensity of the meals they sell by about 7%/year. As mentioned before, the emissions being both endogenous and exogenous (and in this case mostly exogenous), the company will have to take actions internally but also with its suppliers and clients to reach the targets it has set. As we have seen, only a combination of actions from all stakeholders will result in efficient carbon emissions cuts and allow the company to reach both absolute and intensity targets.

Overall, it is important for the company to both study the trajectories for absolute and relative GHG emissions, as one can provide information on the feasibility and pertinence of the other. If the ACT-S methodology and suite allow the study of both, I found that the provided tools were lacking some detail and visualisation, and I therefore had to create my own to realise the feasibility assessment of each trajectory.

3.1.3. Measures to reach these targets

After having defined CCMTs that are coherent with SBTi's 1.5°C or 2°C scenarios, the company had to imagine a list of means to achieve these targets: the key measures of its CCMS. The latter fall into four different categories, called strategic pillars: *eliminate*, *raise*, *reduce,* and *create*. These categories come from the Blue Ocean Strategy methodology (see part 2.3.7. The list of actions is the following:

Strategic pillar n°	ELIMINATE
1	SUPPLY: Blacklisting of off-season fruits and vegetables
2	Remove all plastic containers/packaging and replace them by reusable ones
3	What place for company vehicles in a low carbon world?
4	Stop small production series by orienting menu replacements on existing productions

Table 3.3. Company 1's measures to reach its CCMTs – *Eliminate* strategic pillar

Strategic pillar n°	RAISE
1	SUPPLY: Integrate criteria on animal-based food in the specifications (define practices to black-list or to encourage)
2	Sponsor clients to go further than just one vegetarian menu per week: economic interest
3	Increase the share of biogas vehicles
4	Review the delivery and company vehicles purchases' policy to get rid of fossil fuels
5	Biowaste valorisation on all sites: integrate this aspect in all our offers for clients
6	Increase the share of vegetarian meals in our menus
7	Sale of remainders to be increased (non-conditioned remainders included), and deploy in CLT
8	Integrate this criterion in the specifications to reduce the amount of non-reusable packaging.

Table 3.4. Company 1's measures to reach its CCMTs – *Raise* strategic pillar

Strategic pillar n°	REDUCE
1	**SUPPLY**: Question heated greenhouses
2	Reduce the amount of packaging and individual containers
3	Lower the weight of meat and increase the weight of side-dish, making sure of the nutritious value of the meals
4	Put in place a collective bonus related to fuel consumption of drivers
5	**REDUCE DIRECT EMISSIONS:** Change the cooling units to limit the risks of leaks

6	**REDUCE ENERGY CONSUMPTION:** Standby on less energy-consuming devices
7	**REDUCE ENERGY CONSUMPTION:** Search for financing energetic performance transition
8	**REDUCE ENERGY CONSUMPTION:** Move the headquarters to a low energy consuming place
9	Add carbon criteria in the valorisation of the cost of equipment purchases or investments (full costs method)
10	Awareness raising campaign in favour of low carbon mobility, presentation of existing or future incentives + incentives for low carbon mobility (public transports, bike, ...) and costs of bike maintenance handled by the company
11	Lower delivery frequency without jeopardising the cold link
12	Optimise downstream freight by reviewing delivery criteria offered to clients
13	Reduce the number of deliveries of our suppliers, by increasing on-site stocking capacity and by reviewing conditionings and packaging
14	Reduce empty returns, take profit of the end of delivery tours for local supplying (interconnect upstream and downstream freight)
15	Hire a "zero waste" logistics manager: on logistics, no empty returns, reduce and value the leftovers and unsold products
16	Set a remote working convention with 1 to 2 days + reduction of travels by promoting videoconference meeting
17	Limit waste by offering to re-serve the dish the next day as 2nd or 3rd choice (and explain the reasons/associated zero waste benefits) and do not make the commitment to maintain the contractual choice until the end of the service
18	Reduce the frequency of beef-based dishes in our menus

Table 3.5. Company 1's measures to reach its CCMTs – *Reduce* strategic pillar

Strategic pillar n°	CREATE
1	Raise clients' interests on their carbon savings by a good management of their purchases (purchases by element)
2	Have menus and products for each kitchen according to local availabilities
3	Create a locavore offer
4	Do not announce menus in advance (only the small one of diet plan) to limit food waste Compose menus according to available raw materials. Monetary valorisation for efforts on carbon footprints
5	Last km: low carbon mobility (tricycle, electric vehicle, …?)
6	Get solar or granulate ovens
7	Share the uses of buildings inside/outside of the company Re-think the organisation of the work to limit space usage
8	Install wind turbines on the big kitchens' terraces / solar panels IF SELF-CONSUMPTION
9	Install solar panels and/or wind turbines on big kitchens and headquarters IF SELF-CONSUMPTION

10	Provision of secured bike parking lots on site + Provision of e-bikes charging stations accessible to employees
11	Share our vehicles with others (depending on their availability)
12	Progressively integrate agricultural exploitations engaged in a process of low carbon labelling

Table 3.6. Company 1's measures to reach its CCMTs – *Create* strategic pillar

These measures were imagined after assessing the risks and opportunities related to the company's activity in the future. By gathering them and identifying their likelihood and the magnitude of the associated impacts, the company was able to draw a likelihood-impact matrix, with a triangle of attention characterising the key points it had to focus on to determine the qualitative part of its CCMS. The latter is available in Annex 2.

Then, the company has to calculate the expected carbon emission reductions associated with the measures previously mentioned. This will allow them to prioritise the measures to be taken to have high and fast GHG emission reductions. Unfortunately, in its ACT-S process, Company 1 has not performed any emission reduction assessment. Hence, we can wonder if the company knows how to prioritise its actions for its climate change mitigation strategy. However, the ACT-S suite tool *Strategy Toolbox* includes an "*Action plan"* worksheet to quantify the expected emission reductions associated with a measure. This worksheet also includes the "ClimATE SMART" validation criteria (see section xx.xx), in order to make sure that the measure is well suited for a good CCMS.

3.1.4. Progress achieved with ACT-S

As mentioned at the beginning of this case study, during all the ACT-S process, Company 1 had to answer to a set of questions regarding its maturity on several aspects of its CCMS. Initially, the company under study had an average score of 0.8/4. At the end of the elaboration of their CCMS, this score had increased to 2.2/4. The improvements in the company's strategy can be seen below:

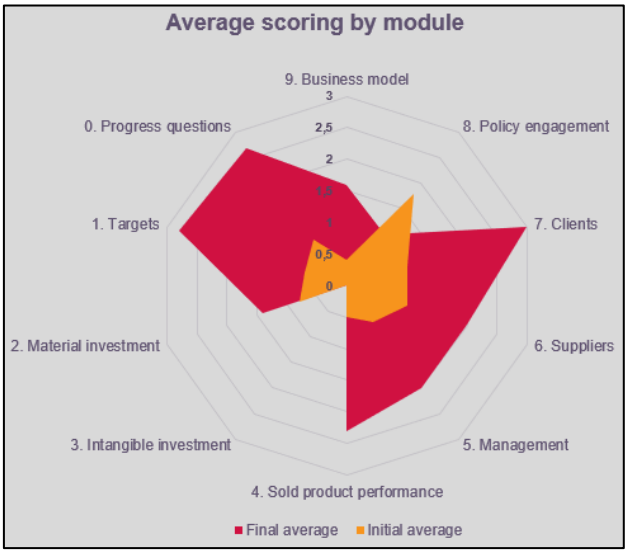

Figure 3.8a. Final maturity scoring of Company 1's CCMS

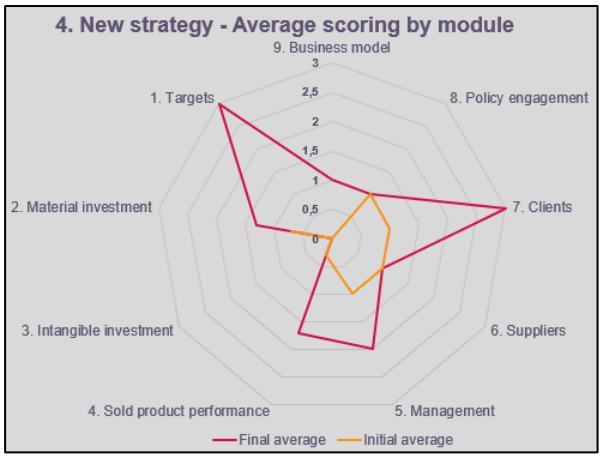

Figure 3.8b. Final maturity scoring of Company 1's new strategy

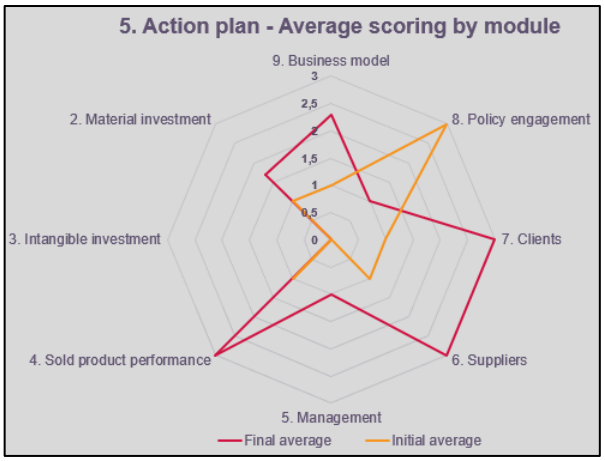

Figure 3.8c. Final maturity scoring of Company 1's action plan

We can see here that important progress has been achieved in several categories, such as *sold product performance* or *clients' engagement*. However, for some modules (e.g., intangible investments, material investments, targets, …), the score remains quite low, showing that Company 1 still has an important margin of progress for the future. This can be explained by the fact that ACT-S is an iterative process: usually the first corporate CCMSs are not performing well on some modules, because the company lacks some experience in climate change mitigation, but its maturity is likely to grow as CCMS and action plan reviews are being carried out. Additionally, in the ACT-S methodology, for the *Generic* methodology[27], the modules *Sold product performance* and *Business model* were deemed to be of major importance for the CCMS. Therefore, the company would have to improve its business model strategy in the future. We can also note that there are some light inconsistencies between the company's strategy and action plan.

3.2. Company 2 – Ford Motor Company

For the second case study, I chose a completely different company from the first one to test the robustness and the adaptability of the ACT-S methodology to a wide range of companies (various sizes, sectors, geographical scopes, …). Hence, I chose the multinational company Ford Motor Company, created in 1903 and employing nowadays more than 170,000 full time employees. The main activity of this company is the manufacture and sale of motorised vehicles, initially only internal combustion and nowadays also hybrid and electric vehicles, with a development of hydrogen vehicles.

As opposed to Company 1, Ford has not carried out an ACT-S process to develop their climate change mitigation strategy. Yet, it is regularly working with the CDP, with which they share their results on their carbon performances and transition plans through the CDP Questionnaire since 2010. Therefore, I filled the different tools of the ACT-S suite thanks to the information they published in these answers and to the information available in their *Sustainability and financial reports*, in order to produce results in accordance with their current level of emissions and vision of the low carbon transition. Indeed, I have tried to reproduce as faithfully as possible their ambition in terms of reduction of impact on climate change. However, some information was not available on any public documents, therefore I had to

[27] The *Progress Grid* toolbox does not contain any specific methodology for the *Agriculture and agrifood* sector.

imagine this information to stay as close as possible to their overall vision. These hypotheses will be mentioned when taken.

3.2.1. Initial situation

For Ford, as the company has not carried out a proper ACT-S process and we only have an overview on the company's vision after the elaboration of their CCMS, we cannot show its initial maturity scoring. Therefore, we will only look at its maturity at the end of the case study.

For the GHG inventory, we will take 2019 as a reference year, for it is the first year for which the company has performed a complete one (scope 1, 2 and 3 with a method in accordance with the GHG Protocol).

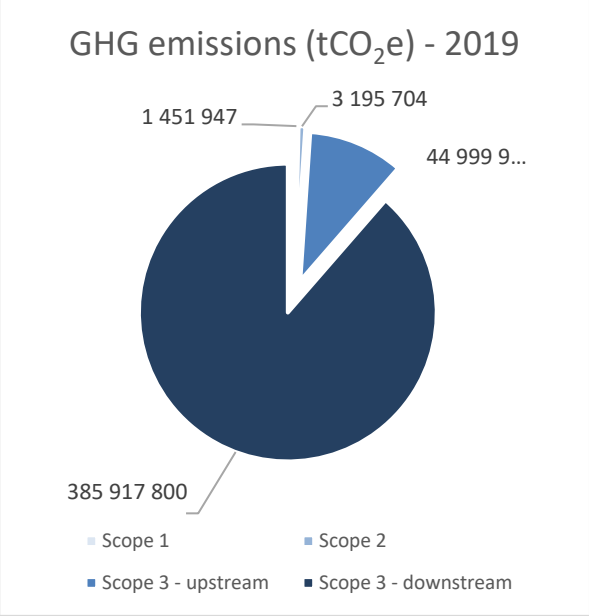

Figure 3.9a. GHG inventory of Ford, 2019

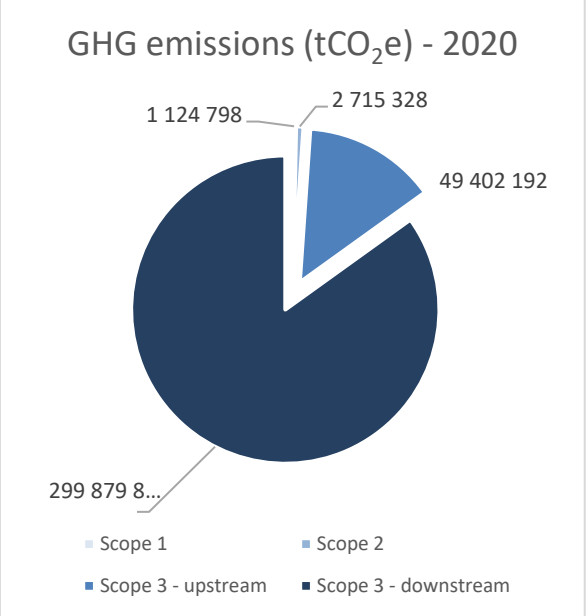

Figure 3.9b. GHG inventory of Ford, 2020

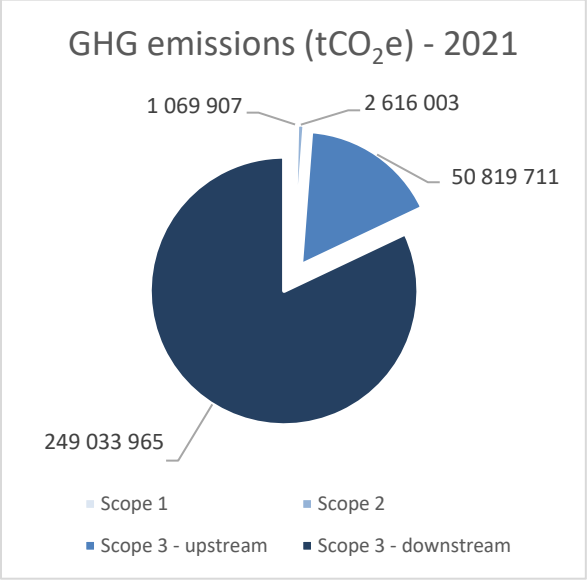

Figure 3.9c. GHG inventory of Ford, 2021

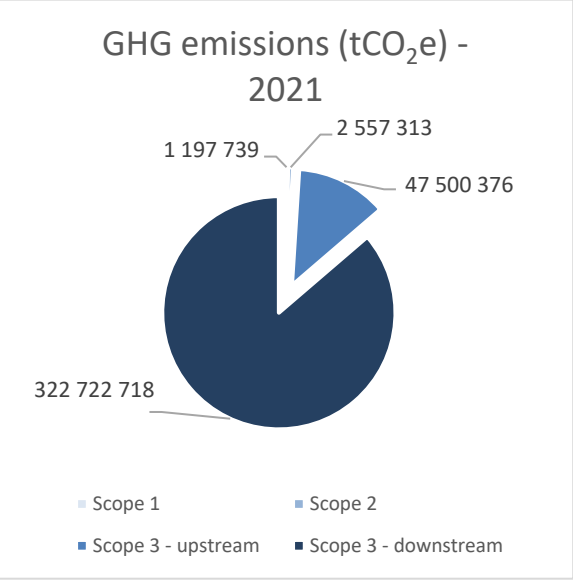

Figure 3.9d. GHG inventory of Ford, 2022

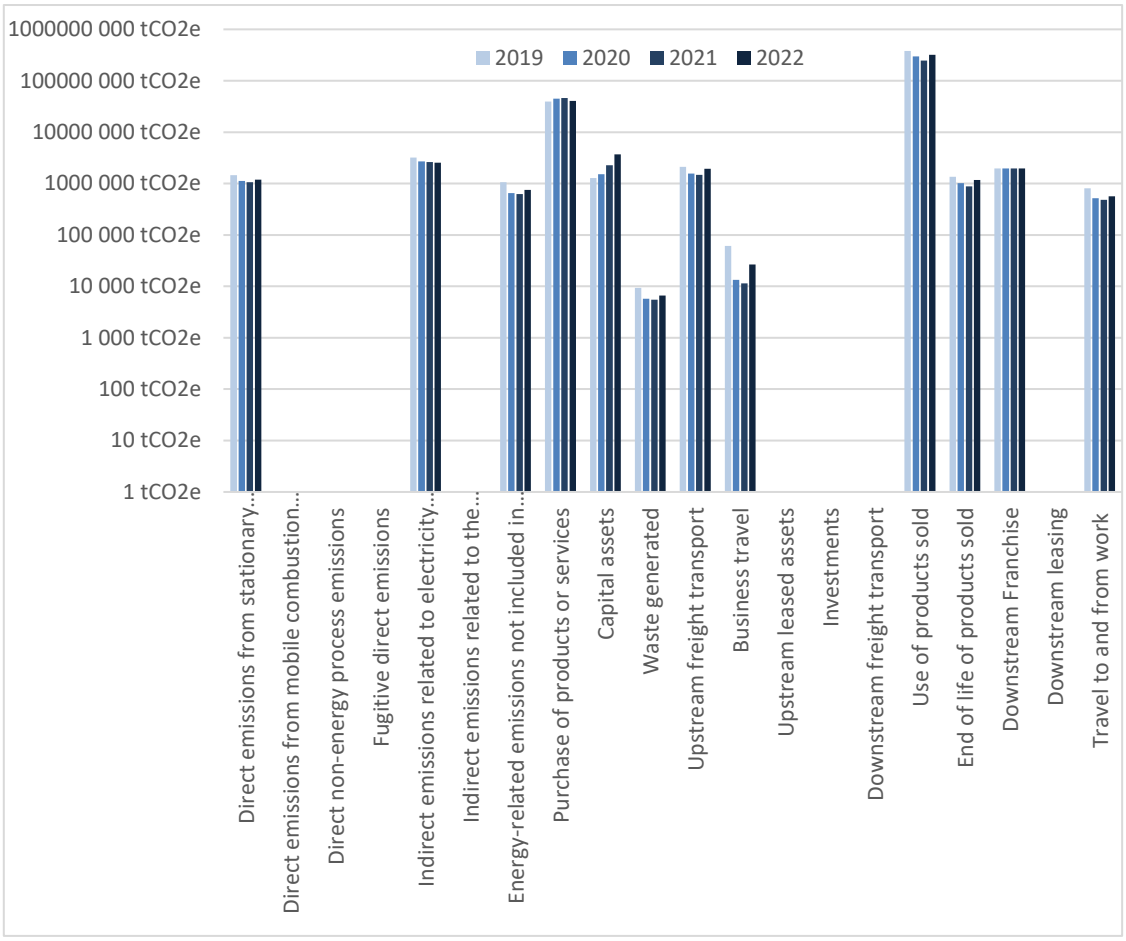

Figure 3.10. GHG inventory of Company 1 per year and emission category (log scale)

We can see on the previous graphs that for the 4 years of reporting, the majority of the GHG emissions of the company come from the scope 3, similarly to Company 1. However, this time, the main emission category is "Use of products sold", representing 87.8% of the total emissions of Ford for 2019, resulting in a predominance of downstream scope 3 emissions. Then, the remaining emissions mostly come from the "Products and services purchased" category, accounting for 9.1% of the total emissions in 2019. The results are quite similar for years 2020 and 2021, despite some variations in downstream scope 3 emissions, due to less vehicles sold throughout and after the COVID-19 pandemic, resulting in less emissions in the "Use of products sold" category. Hence, the company should put the emphasis on these two categories previously mentioned for its CCMS, in order to reduce efficiently its emissions in the long-term.

After having looked at the repartition of the GHG emissions of Ford, we will now use the Carbon performance tool of the ACT-S suite to evaluate the pertinence of Ford's currently stated CCMTs in comparison with SBTi's benchmarks.

3.2.2. GHG emissions reduction: benchmarks and company's targets

As with Company 1, we will first study the trajectories of economic growth of the company. As with Company 1, only one trajectory is known in terms of revenue: the expected revenue growth of the

company. Hence, I added two other trajectories: a no growth trajectory and a 1% degrowth trajectory. The expected revenue growth of the company is said to be of about +1.5% to +1.87% per year (Simply Wall St, 2023), until 2028-2030, where Ford's revenue is expected to stabilise around US$ 152bn (Statista, 2023). Similarly, the prospects on Ford's sales tell us about a 2.9% growth rate until 2028-2030, and then a stabilisation of the sales around 5 million of vehicles sold per year.

Scenario	Vehicles sold growth	Number of vehicles		
		2021	2035	2050
Business as usual	+5%	3.92 M	5.00 M	5.00 M
No growth	+0%	3.92 M	4.25 M	4.25 M
Degrowth	-1.5%	3.92 M	3.49 M	2.78 M

Table 3.7. Number of vehicles sold – comparison between the scenarios

3.2.2.1. Ford's stated scenario

The objectives in terms of GHG emissions reductions, stated in their *Financial and Sustainability reports*, are as follows:

- 76% reduction for scopes 1 and 2, between 2017 and 2035
- 50% reduction for scope 3, between 2019 and 2035

This trajectory can be visualised in the following graph, along with the actual GHG emissions from 2019 to 2021.

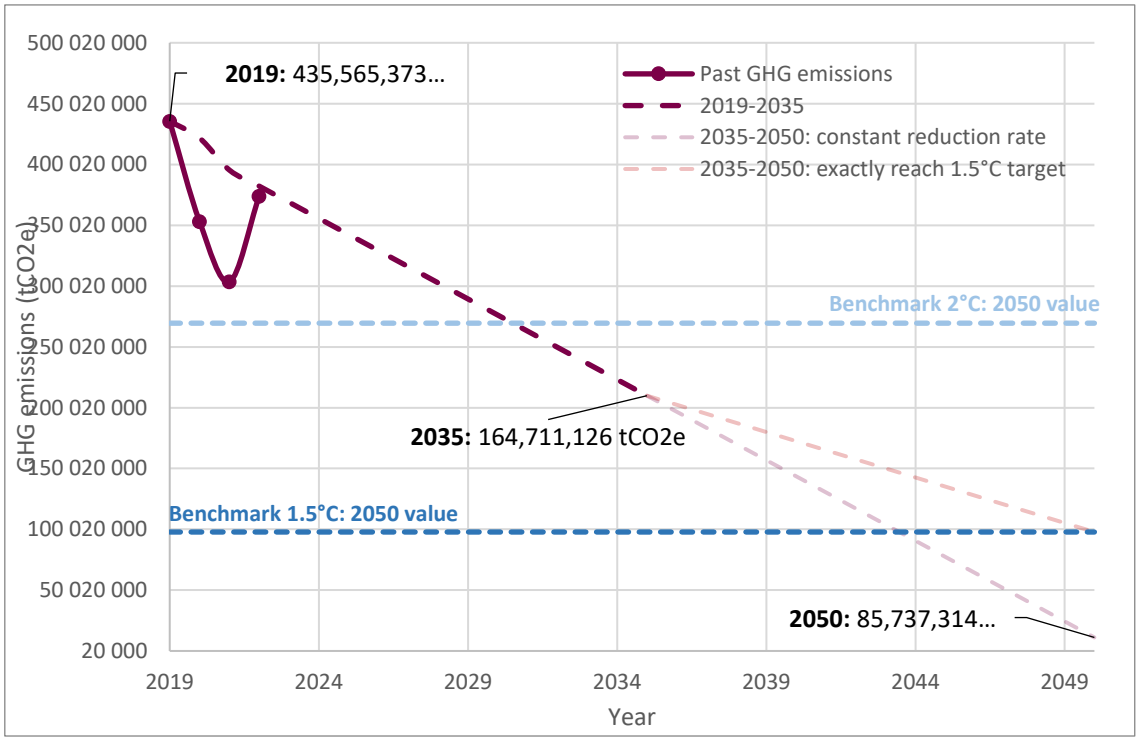

Figure 3.11. Evolutions of GHG Emissions (scopes 1, 2 & 3) for Ford's stated target scenario

What can directly be seen here is that the actual emissions are way below the target trajectory set by the company in 2020 and 2021. However, it does not mean that the company has taken important action to cut its GHG emissions. Indeed, because of the COVID-19 pandemic, the company's sales dropped from

5.39 million of vehicles sold in 2019 to 4.23 million in 2020 (27,2% decrease) and 3.94 million in 2021, thus reducing the company's overall GHG emissions. On the contrary, when we take a look at the carbon intensity per vehicle sold, we can observe an important increase: from 80,870 $kgCO_2e$/vehicle sold in 2019 to 107,131 $kgCO_2e$/vehicle sold in 2021. We can therefore question the pertinence of using the year 2019 as a reference for the scope 3 targets: this year corresponds to a pre-COVID situation, with the highest historical sales of the company, whereas the company's current sales do not reflect this situation anymore (even though 2022 emissions show a "back to normal" fashion for the emissions and the sales). Hence, I analysed the difference between a 2019-based scenario and a 2020-based scenario. The results are shown in Figure 3.12.

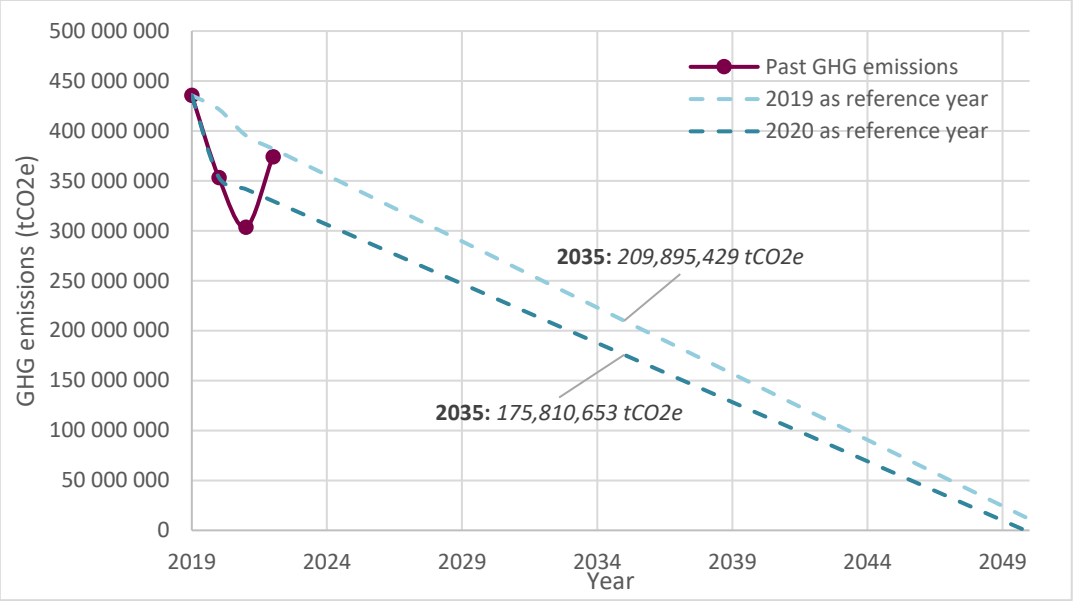

Figure 3.12. Comparison between a 2019-based scenario and a 2020-based scenario

We can see on the previous figure that depending on the chosen scenario, we end up with a 34 $MtCO2_e$ difference in 2035, but this different is way lower in 2050, if we keep the same reduction rate between 2035 and 2050 as for the period 2019/2020-2035. However, if this difference seems negligible in terms of yearly GHG emissions, especially in the later years of the scenario, this is not the case when we compare the cumulative GHG emissions (aspect not considered by the ACT-S methodology, as mentioned in the previous case study). Effectively, when we sum up the emissions between 2019 and 2050, we obtain a 19.9% difference between the two scenarios, which corresponds to an additional 1.466 $GtCO_2e$ for the 2019-based scenario. Consequently, the choice of a 2020-based scenario would be more efficient in terms of climate change mitigation. Hence, the ACT-S methodology shows again its limit in terms of CCMTs setting: despite the recommendations on the slopes of trajectories to follow, the lack of precision concerning the base and end year leads to non-negligible differences in terms of emissions, which fails to address efficiently the issue of global climate change.

But as mentioned at the beginning, the idea behind this case study is to analyse Ford's vision to assess the pertinence of their scenarios in reducing their GHG emissions as recommended by the SBTi, and the quality of their CCMS. Therefore, I will keep a 2019-based scenario for the rest of my analysis. Moreover, we do not know why the company chose to only set targets for 2035 and not up until 2050. We will thus try to extend the trajectories to the period 2035-2050, to be able to have long-term targets for this company as well.

3.2.2.2. *Comparison of stated scenarios with benchmarks – absolute emissions*

For this case study, I do not have any information concerning the source of the target GHG emissions reduction rates. The -76% and -50% objectives seem to have been determined by Ford after studying the SBTi's recommendations, but the company does not clearly state the reflexion process lying behind these values. As these targets are quite ambitious, we will study three other scenarios:

- a +2°C-aligned scenario, for which the 2050 GHG emissions are equal to the 2050 target of the +2°C benchmark: -19.5% emissions between 2019 and 2035; -38% between 2019 and 2050.
- a +1.5°C-aligned scenario, idem but with the +1.5°C benchmark: -40% emissions between 2019 and 2035; -78% between 2019 and 2050.
- a transport sector-based SBTi +1.5°C benchmark: -89% emissions between 2019 and 2035, and zero emissions in 2050.

We can add these scenarios and the benchmarks to the previous graph, to visualise the different trajectories:

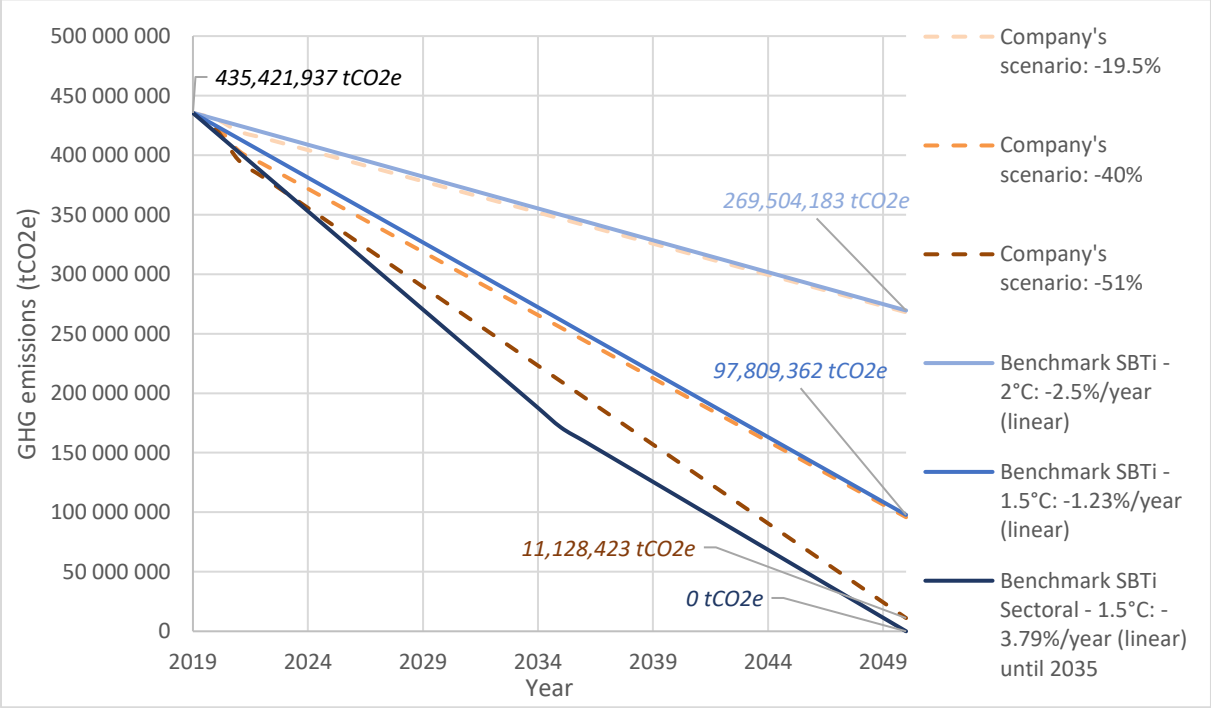

Figure 3.13. Comparison of different scenarios with the three generated benchmarks

We can see here that the target stated by Ford for 2035 is more ambitious than the target of the generic SBTi's +1.5°C trajectory. Indeed, it consists in a 3.14% yearly contraction of GHG emissions, as opposed to the WB2C scenario, which recommends a 2.5% yearly reduction of GHG emissions. In the end, it would result in a 97% reduction of Ford's total GHG emissions between 2019 and 2050. However, their stated scenario is less ambitious than the transport sectoral SBTi benchmark, which recommends a 3.79% yearly decrease in GHG emissions until 2035, and then a linear decrease towards zero. This last scenario needs to be handled with care, because as opposed to the other SBTi benchmarks, it concerns the company's net GHG emissions, and not its gross emissions. Therefore, in terms of gross emissions, the target for this trajectory would not be equal to zero: the company's stated policy is likely to be aligned

with such a scenario. Despite the attractive aspect of such trajectory in terms of climate change mitigation, one could wonder whether such an important reduction in absolute GHG emissions is realistic. This aspect will be studied now.

3.2.2.3. Comparison of stated scenarios with benchmarks – carbon intensity

In order to assess the credibility of GHG emissions reduction scenarios, as I did previously for Company 1, I will study the different trajectories in terms of carbon intensity. For the automotive sector, some emission factors are available for road vehicles, mostly expressed in $kgCO_2e/km$ or $kgCO_2e/passenger.km$. Unfortunately, these carbon intensity indicators are user-oriented, as they express, during the vehicle's lifetime, how much GHG the owners of the vehicle will emit. From the manufacturer's point of view, we must use other indicators, as we do not have access to precise information concerning the use of the vehicle, its lifetime, etc., and as we also must count more emissions that are taken into account in the "vehicle's manufacturing" part of the user-oriented emission factor. Therefore, for this analysis, I chose to study the following carbon intensity indicator: carbon intensity per km, expressed in $kgCO_2e/km$[28]. I have also studied the carbon intensity per € of revenue, expressed in $kgCO_2e/€$ of revenue, but as the results were very similar to the ones per kilometre, I chose to only display them for the first indicator in this report. To calculate this indicator, I applied the following formula:

$$carbon\ intensity\ per\ km_{year\ y} = \frac{total\ GHG\ emissions\ of\ Ford_{year\ y}}{\#\ vehicles\ sold_{year\ y} \cdot lifetime\ distance\ per\ vehicle}$$

with lifetime distance per vehicle taken equal to 200,000 km.

Therefore, this indicator is, by a factor of 200,000, the same as the carbon intensity per vehicle sold.

As mentioned before, three revenues/sales growth scenarios were studied: *business as usual*, *no growth*, and *degrowth*. And as far as the GHG emissions are concerned, we only study the *-51%* (Ford's currently stated scenario). I also compared the performances and trajectories of Ford with other companies' 2019 carbon intensities per kilometre for their vehicles.

The carbon intensity per kilometres, the results are as follow:

[28] **NB:** this indicator does not reflect the GHG emissions of a vehicle from a user point of view. Here, some emission categories, such as *employees commuting* or *capital assets*, are counted while they are out of the scope of the life-cycle assessment of a vehicle. Therefore, the values of this indicator will be slightly higher than the well-to-wheel carbon intensity of a vehicle.

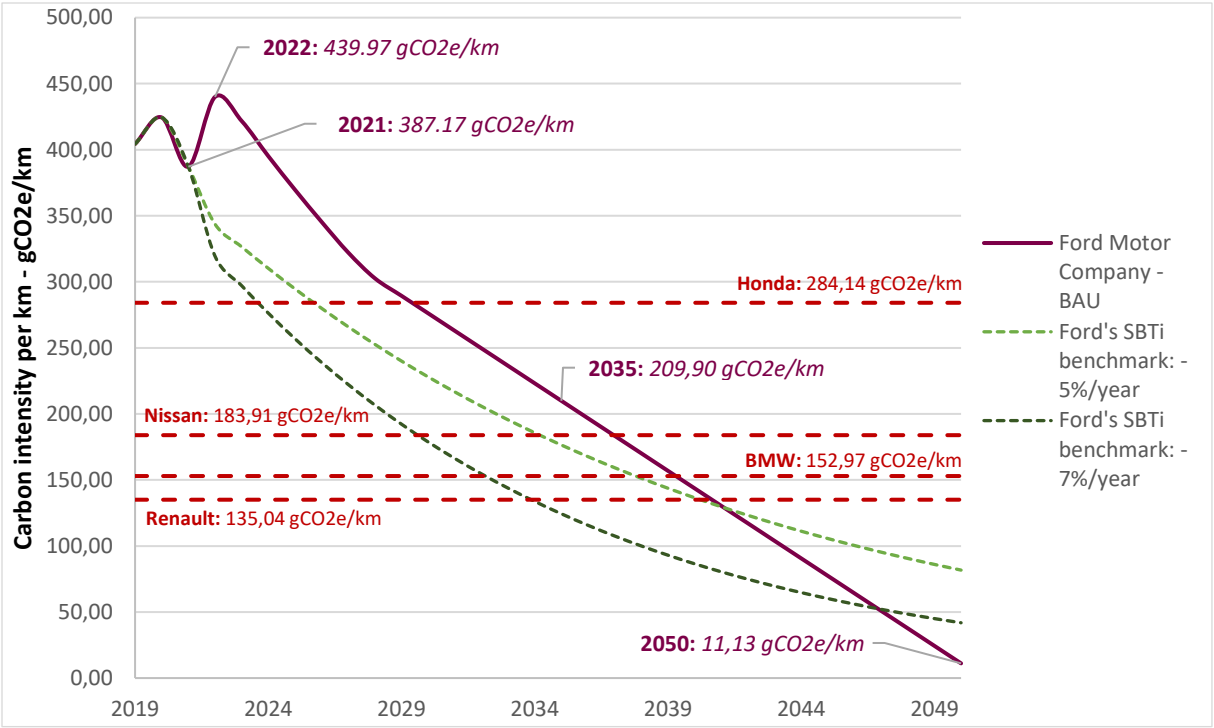

Figure 3.14a. Scenario of evolution for sold vehicles' carbon intensities, compared to SBTi's benchmarks and other company's carbon intensities – BAU

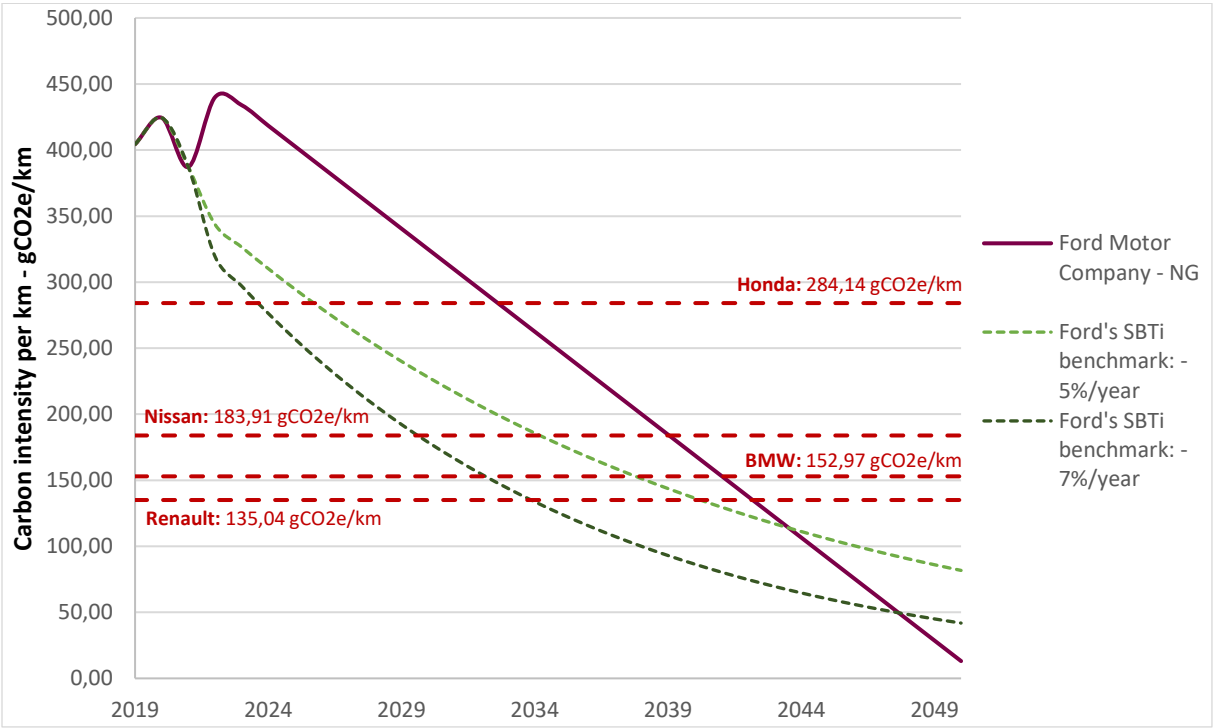

Figure 3.14b. Scenario of evolution for sold vehicles' carbon intensities, compared to SBTi's benchmarks and other company's carbon intensities – No growth

First, we can note that, as mentioned before, even though the company's absolute GHG emissions decreased by a lot with the COVID-19 pandemic, as the sales were also way lower this year, the carbon intensity for the vehicles sold was higher in 2020 and 2022.

Then, we can see that the *business as usual* and the *no growth* scenarios are close in terms of 2050 vehicle carbon intensity targets (19,166 $kgCO_2e$/vehicle for *BAU* and 22,548 $kgCO_2e$/vehicle for *NG*, for the -40% scenario). Moreover, by comparing the initial performances of Ford to the ones of its competitors, we can clearly see that they are way lower than theirs: for example, in 2019, while Renault Group's vehicles had a carbon intensity of about 135 gCO_2e/km, Ford's vehicles were at about 400 gCO_2e/km, that is to say 3 times higher. This difference can be explained by the fact that the CDP, organisation collecting the data from companies – where the data for this calculation came from – does not have a standardised method to realise and report the GHG emissions. Hence, some important gaps may be found between two companies, even though in reality their GHG emissions may be close. However, it seems unrealistic that this huge difference lies only in methodology choices (especially when we know that all the companies displayed here had a score of A or A^- to the CDP Questionnaire). We can therefore consider that Ford is actually less performant than its competitors. Several explanations can be imagined for this lower performance:

- Ford's factories may be located in areas where electricity is carbon intensive.
- The raw materials and components bought by Ford are also carbon intensive.
- the vehicles sold by the company have much higher emissions[29], due to their size or power (SUV, pick-up trucks, …), and type of motorisation (low share of electric or hybrid vehicles compared to its competitors).

Regardless of the current relative performance of the company: two clear objectives can be seen on the previous graphs (to avoid too much commenting I will only deal with the business-as-usual scenario, as it represents Ford's current vision).

> Indeed, first we have the absolute target, studied before, but transcribed into a carbon intensity target in gCO_2e/km. The latter is of 209.90 gCO2e/km in 2035 and of 11.13 gCO_2e/km in 2050, corresponding to Ford's stated scenario. In concrete terms, in means that Ford would have to reach in 2035 a carbon intensity corresponding to the current average of the market and, in 2050, a near-zero carbon intensity.
>
> Then, we have the intensity target, which is embodied by the curve dashed lines (Ford's SBTi benchmarks). The latter states that a similar target should be reached in 2050 (near-zero intensity: 41.87 gCO_2e/km), but 2035's target is much lower than for the absolute target: 124.35 gCO_2e/km, which corresponds to an intensity lower than the current lowest carbon intensity in the market.

The main difference between these two targets lies, once more, in the difference between the cumulative GHG emissions between 2019 and 2050. Effectively, while following the absolute targets would result in about 6,955 $GtCO_2e$ emitted in this period, for the intensity targets, it would result in 4,952 $GtCO_2e$ emitted (2,003 $GtCO_2e$, that is to say 28.8% difference).

[29] It is important to note here that Ford is also selling freight vehicles such as trucks.

Now, in terms of feasibility, 2035's targets seem reasonable as they correspond approximately to the current carbon intensities of the Ford's competitors. As for 2050, the issue is the same as for Company 1: as Ford's GHG emissions mostly fall into the scope 3 category, it means that these emissions are both endogenous and exogenous to the company. Therefore, part of the reduction of GHG emissions will come from the decarbonisation of its suppliers' activities. However, here, most of the emissions come from the use of the products sold and particularly from the combustion of fuel to use their vehicles. Hence, despite the exogenous aspect of these emissions, Ford has the action lever for this, which is the motorisation choice for the vehicles it will sell in the future. Effectively, nowadays, an electric vehicle can have a usage carbon footprint about twice as low as an internal combustion vehicle: in France in 2018, these carbon intensities were of 212 gCO_2e for an average diesel vehicle and of 103 gCO_2e/km for a compact electric vehicle (ADEME, 2023), and globally internal combustion vehicles have a lifetime carbon footprint of 41.9 tCO_2e, whereas battery electric vehicles' one is about 21.1 tCO_2e (IEA, 2021). Thus, the 2050 objectives also seem achievable, but would require coordination between Ford – which would have to review its vehicle offer and business model –, its raw materials suppliers and also energy suppliers.

As far as other vehicle manufacturers are concerned, if we look at their carbon intensity targets (with a -7% SBTi benchmark), the 2050 values are similar: 14.24 gCO_2e/km for Renault Group, 19.39 gCO_2e/km for Nissan Motor Co. and 29.96 gCO_2e/km for Honda Motor (all near-zero). Nevertheless, the efforts to reach these targets will likely be more important for Ford, as the current carbon intensity of its activities is much higher than its competitors'.

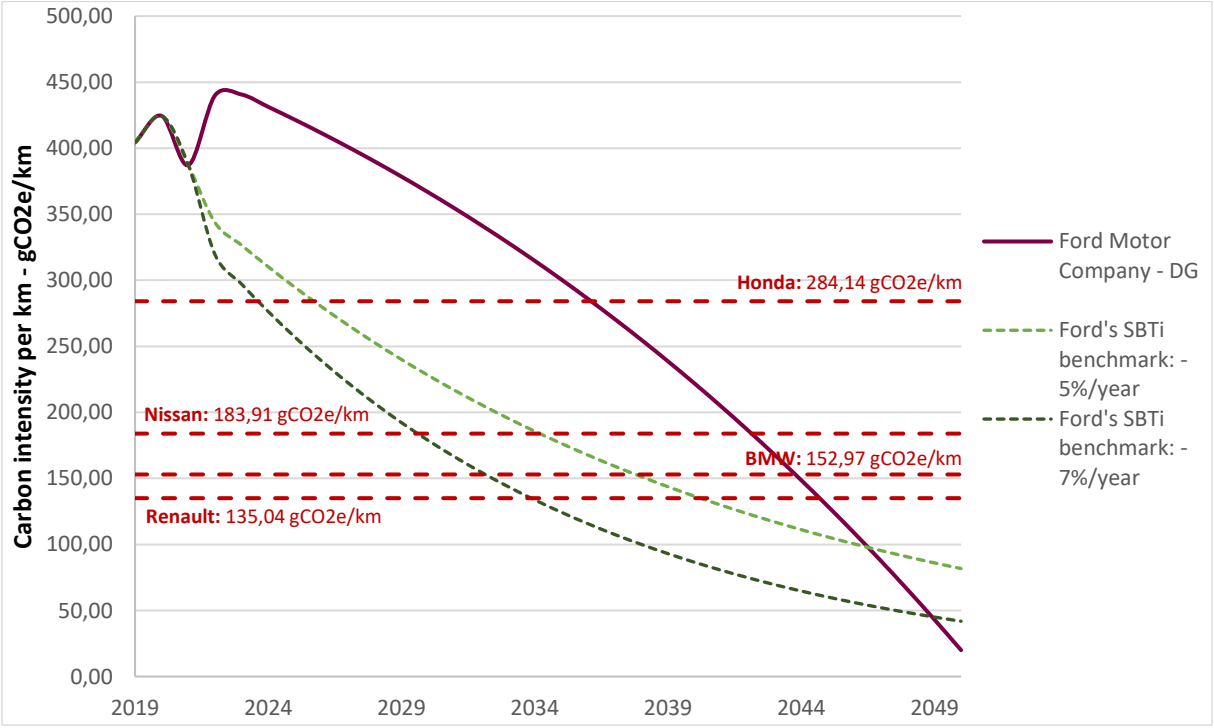

Figure 3.14c. Scenario of evolution for sold vehicles' carbon intensities, compared to SBTi's benchmarks and other company's carbon intensities – Degrowth

As far as the degrowth scenario is concerned, the difference in terms of cumulative emissions between absolute and intensity targets is way more important than for the business-as-usual an no growth ones. Therefore, such an absolute target trajectory should be proscribed, and the intensity trajectory should be

preferred. However, this scenario depicts a case in which Ford's future annual vehicle sales would decrease, a desirable scenario for several reasons: higher vehicle lifetimes and preference of second-hand vehicles, resulting in lower uses of new raw materials and disposal of products at the end of their life, or reduction of the dependence to personal vehicles and development of public transportation. In conclusion, ACT-S methodology, and carbon trajectories in general, are effective when it comes to GHG emissions and direct climate impacts, but do not reflect the reality in terms of social impacts or rebound effect.

3.2.3. Measures to reach these targets

After having studied the different targets in terms of GHG emissions reduction, we now need to look at the concrete measures imagined by Ford to reach these objectives. Unfortunately, this qualitative part of the CCMS does not contain information as precise as I had for Company 1, as the latter has specifically expressed its strategy within an ACT-S process and the only information I had access to for Ford was the one publicly available and displayed on its website and reports. Still, I was able to list the risks and opportunities related to the company's activities and draw the triangle of attention for the definition of the action plan. The latter has been reported in Annex 3.

From this triangle, we could derive a list of adapted and prioritised actions for the company to take. However, as Ford already had published its sustainability strategy, I used the latter as a basis for writing down a list of elements depicting the company's vision for the future, again with the Blue Ocean method. The results are as follows:

Strategic pillar n°	ELIMINATE
1	Elimination of single-use plastics from our operations by 2030

Table 3.8. Ford's measures to reach its CCMTs – *Eliminate* strategic pillar

Strategic pillar n°	RAISE
1	Produce electric vehicles at an expected rate of more than 2 million annually by the end of 2026 (about one-third of Ford's global volume)

Table 3.9. Ford's measures to reach its CCMTs – *Raise* strategic pillar

Strategic pillar n°	REDUCE
1	Required suppliers to set science based GHG reduction targets
2	Purchase electricity from only renewable sources for all European operations
3	Strategic partnership with Manufacture 2030 (M2030) to enhance supply chain sustainability
4	100% passenger vehicle range in Europe with zero-emissions capable, all-electric or plug-in hybrid by 2026
5	50% of global sales volume being electric vehicles by 2030 (50% in the US, 100% in EU)
6	Purchase at least 10% near-zero carbon steel and aluminium as part of our commitment to the First Movers Coalition by 2030
7	Required suppliers to set science based GHG reduction targets

Table 3.10. Ford's measures to reach its CCMTs – *Reduce* strategic pillar

Strategic pillar n°	CREATE
1	Launch all-new electric passenger vehicle in Europe in 2023
2	Build next generation electric truck and battery packs with SK Innovation at BlueOval City by 2025
3	Invest $35 billion/year (in average) to support public EV chargers between 2022 and 2030

Table 3.11. Ford's measures to reach its CCMTs – *Create* strategic pillar

3.2.4. Final maturity of Ford's CCMS

As mentioned at the beginning of this second case study, I only had access to Ford's final CCMS (and thus vision of the company in a low-carbon market). By answering ACT-S' *Progress Grid*'s questionnaires thanks to the different information I had of their vision and ambitions, along with what I understood throughout the analysis of their goals, I was able to produce the following figure:

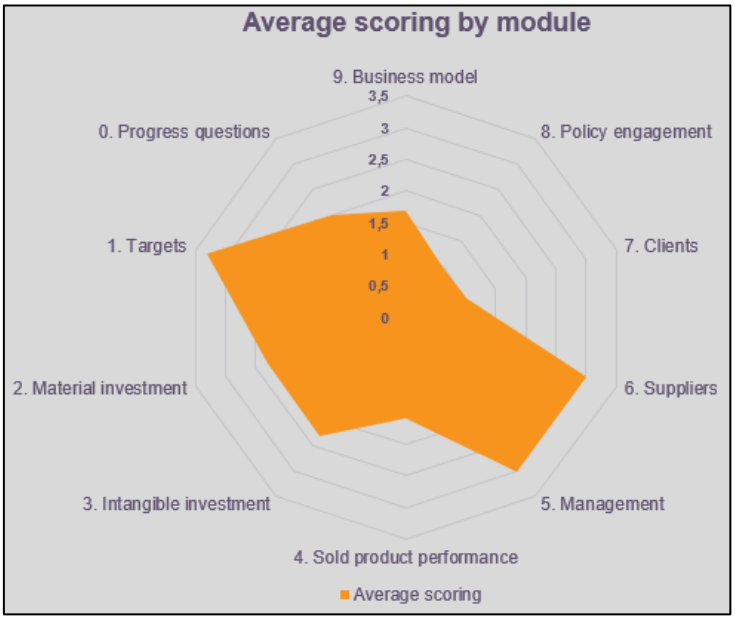

Figure 3.15. Final maturity scoring of Ford's CCMS

We can see here that if the *Targets* module has a very good score (3.3/4), it is not the case for all of them. Effectively, modules 4, 7, 8 and 9 have a rather low score (not higher than 1.75/4), so there is room for improvement on Ford's strategy on these points. For the *Automotive* methodology, the major modules are *Intangible investment* and *Management*. Hence, Ford would have to put the emphasis on its intangible investment's strategy for their future reviews of CCMSs. Overall, the company's CCMS obtained an average score of 2.1/4 with this notation system.

3.3. Conclusion on the case studies

Through these two case studies, we have been able to study different aspects of CCMS elaboration, and especially with the use of the ACT-S methodology for Company 1 and of SBTi for Ford. The specificities of each company (different sectors, sizes, material emission categories, …) helped us understand better the techniques for target setting and action planning, but also test the adaptability of the methodology we wanted to study.

Overall, we have seen that the use of ACT-S tools is well guided, with step-by-step instructions and questionnaires to monitor the advancement of the CCMS elaboration process. These toolboxes are quite intuitive, and this makes their use quite easy, even for people with little knowledge on this topic. For both companies, the target setting has been quite efficient, as can be seen with the final maturity scoring of the *Targets* module. The two case studies carried out for this thesis showed that the targets determined thanks to this methodology are indeed aligned with a +2°C trajectory (or even with a +1.5°C one, depending on the company's ambition), and that ACT-S effectively helps companies imagine a series of action it could implement in its business strategy to reach the emission goals priorly set.

However, its performance has not been as high for every other aspect of the corporate climate change mitigation strategy. Indeed, a particular attention has been given to target setting: for both companies, the newly set targets were aligned with a +2°C scenario, according to the different benchmarks that had been studied (mostly generic and sectoral SBTi benchmarks). Yet, on the other hand, the case studies also pointed out that while companies tend to take the target setting phase seriously, unfortunately it is not the case for the action plan elaboration and validation steps. As a matter of fact, it seems like companies tend to confuse CCMSs for CCMTs: the impact quantification for each measure and its potential to help the company reach the objectives priorly set may have been underestimated or neglected. Nevertheless, CDP's analysis of past emission trends showed it: CCMTs alone are ineffective to address climate change, they need to be backed by solid, concrete and adapted measures which have been associated with quantified emission reduction potentials and costs (not only monetary but also in terms of time, workforce and stakeholders involved).

Furthermore, I mentioned it in chapter 2.4: the lack of credibility analysis of a CCMS is a gap of ACT-S which needs to be closed. Effectively, we have seen here that the phases of the elaboration of a CCMS which were the most guided (i.e., diagnostic of current performance and target setting) were the steps for which both companies have performed better. On the contrary, it seems like the companies under study went faster on step 5A (i.e., elaboration and validation of the action plan), maybe underestimating the importance of the aspects the latter covers. Once again, the existence of an overseeing entity aimed at providing feedback to the companies engaged in an ACT-S project would be useful in order to prevent this lack of precision for some steps of the elaboration of CCMSs.

4. Conclusion

Because of all warning signals on global climate change sent out by climate experts during the last few decades, and especially the huge work of the International Panel on Climate Change, the world has understood that this issue had to be taken seriously. To maintain a viable world and limit the adverse effects of climate change, the global warming must be kept below a certain threshold: the higher the global warming index, the higher the strength and frequency of occurrence of extreme weather events, natural disasters and other negative impacts on human lives and the environment. As a consequence, in 2015, with Paris's Agreement on climate change, 197 countries decided to limit global warming below +2°C (as compared to the average in the pre-industrial period) and move towards a +1.5°C alignment. Then, each government started to establish their own strategy to meet this objective, determining GHG emission targets that would not exceed the remaining carbon budget estimated by the IPCC. It has been understood that companies have an important role to play in these emissions reductions and therefore that they would also have to set their own GHG emission trajectories, goals, and actions to meet the latter. However, in 2015, the Carbon Disclosure Project pinpointed that if 80% of the world's most emitting companies had set GHG emission targets, emissions still increased from 2010 to 2015 for most of them. Within this scope, this organisation, along with the Science-Based Target initiative, identified a need to help companies develop proper climate change mitigation strategies, to efficiently cut their GHG emissions through effective actions and launched ACT step-by-step, a corporate climate change mitigation strategy elaboration methodology, in 2019. As this method is quite recent, no real proof of its performance had been published in the scientific literature. Consequently, my purpose with this thesis was to study the process of CCMS building and the role of ACT-S in this task.

With my thesis, I wanted to define and characterise climate change mitigation strategies to propose a method for their elaboration, by carrying out a review of the scientific literature and studying similar and complementary initiatives. Then, my goal was to analyse the elements of methodology composing ACT-S and to confront them with the criteria on CCMS performance priorly established with the literature review, to assess the method's suitability for building corporate CCMSs, and underline its strengths and limitations. Finally, I completed the previous critical analysis with two case studies to best understand, in practice, the potential gaps of ACT-S.

Throughout this study, I have been able to propose a definition of climate change mitigation strategies, based on an analysis of the terminology used in this topic and on other partial definitions from the literature. Then, by analysing the ACT-S methodology and studying other methodologies and initiatives linked to climate change mitigation, risks analysis and strategic planning, I have been able to provide a fresh method for the elaboration of corporate CCMSs, with connections with the initiatives priorly investigated, completing the one ACT-S was offering. Indeed, I included prerequisite steps such as the realisation of a GHG inventory and the training of the ACT-S workgroup's members to climate change and mitigation strategies, which I deemed to be mandatory to carry out a good ACT-S project. Moreover, some additional steps after the finalisation of the ACT-S process which can improve the company's CCMS, by adding several elements such as a strategy to move toward a net-zero emission business or a climate change adaptation strategy, were also added.
Furthermore, the theoretical and practical analyses of the ACT-S methodology allowed me to certify its good performance as far as CCMS building is concerned, as it was fulfilling most quality criteria concerning long term climate strategies and CCMTs, although it can still be strengthened by other complementary tools studied in this report. However, some of its elements and the way it is used by

companies constitute a limitation to its performance, and therefore some recommendations of recommendations have been expressed in this thesis, after highlighting these different gaps.

In order to improve the current methodology offered by ACT-S, and avoid potential misleading, some recommendations could be made for its future versions. First of all, some elements on which it is based, in particular the IEA's scenarios, could be modified or cross-checked with other scenarios and trajectories calculated by other independent organisations. This would allow a comparison between several potential sectoral trajectories and open ACT-S to new suggestions in terms of evolutions of businesses. In addition, a more frequent updating schedule would be appreciated, to always make sure to have the last available data or recommendations.
Furthermore, the methodology could gain in precision in several aspects. By developing new sector-specific targets and recommendations, we would help companies currently falling in the *Generic* sector methodology establish more effective CCMSs, with truly adapted emphases on some modules and emission categories. Precision could also be gained through the clarification of some points like the determination of the base year, the validation of measures in the action plan and the consideration of non-CO_2 GHG emissions. Some considerations about fairness and equity across different countries would also be appreciated, as the current method ignores these points that are paramount to build a sustainable world along with social and climate justice. In addition, other planet boundaries – such as aerosol loading, freshwater use, or biogeochemical flows for example – should be added to the methodology's scope, so that negative impacts' referral are avoided as much as possible. All the points previously mentioned would require the creation of specific rules or recommendations for companies to follow.
Finally, the elaboration of CCMSs should be the subject of an international join effort. This involves the creation of a standard on CCMTs setting and the establishment of climate action plans. This standard would allow efficient corporate responses to climate change, guaranteeing effective transition plans worldwide, along with the possibility of comparing results between companies. For this, the ACT-S methodology could be used as a cornerstone. This standard could be accompanied by an accreditation, delivered by a global overseeing institutional authority. The role of the latter would be to analyse companies' CCMS and judge of their quality and credibility. If considered satisfying, the CCMS could be validated by this official institution. The existence of such an accreditation would prevent unrealistic CCMSs to be disclosed publicly, falsely luring clients and investors with greenwashing communication. This authority would also play the role of an advisor, providing recommendations and feedback on CCMSs, based on the standard and on success stories from other companies.

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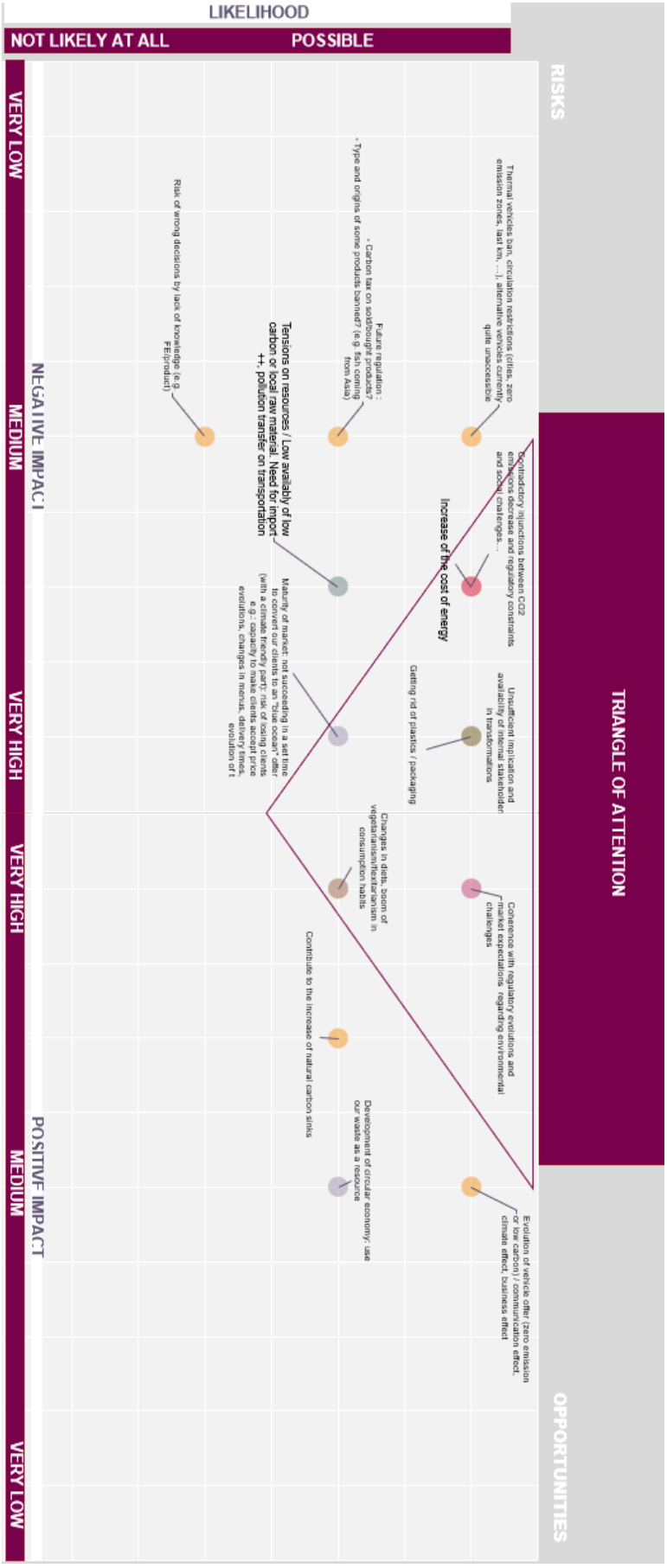
Annexes

Annex 1. How SDA CO_2 budgets were derived from the IEA's 2DS (SBTi, 2015)

Scope 3 category	Direction to set targets in line with a 2°C pathway
Category 1: Purchased goods and services	Set target based on the 2 °C pathway of the applicable supplier sector (e.g. the chemical sector for companies purchasing chemical compounds).
Category 2: Capital goods	Set target based on the 2°C pathway of the applicable supplier sector.
Category 3: Fuel- and energy-related activities	Not covered in current method.
Category 4: Upstream transportation and distribution	Set target based on 2°C pathway of light passenger transport sector.
Category 5: Waste generated in operations	Parts of the waste disposal process, like transport and waste management services, can be covered by the method. Incineration or landfill emissions are not covered by the current method.
Category 6: Business travel	Set target based on the 2°C pathway of the light passenger transport and aviation sector.
Category 7: Employee commuting	Set target based on the 2°C pathway of the light passenger transport sector.
Category 8: Upstream leased assets	Set target based on the 2°C pathway of the service buildings sector.
Category 9: Downstream transportation and distribution	Set target based on the 2°C pathway of the light passenger transport and aviation sector.
Category 10: Processing of sold products	Not covered in current method.
Category 11: Use of sold products	Besides the use of light duty vehicles, scope 3 emissions of other sold products are not covered in current method, and target setting is not yet possible. However some aspects related to the emissions of sold products are included in the background of the method: - General energy efficiency improvements will reduce the impact per sold product and are included in the scenario's for final energy demand per year; - Increased renewable energy production will in time reduce the emissions per sold product.
Category 12: End-of-life treatment of sold products	Not covered in current method.
Category 13: Downstream leased assets	Set target based on the 2°C pathway of applicable sector of the leased asset (like for instance service/ commercial buildings).
Category 14: Franchises	Set target based on the 2°C pathway of applicable sector of the franchisee (like for instance service/ commercial buildings).
Category 15: Investments	This category is specifically targeted toward financial institutions where the majority of emissions are related to their investing and lending activities. Targets can be set based on the 2°C pathway of the applicable sector of the investee.

Annex 2. Company 1's triangle of attention



Annex 3. Ford's triangle of attention