*How are O&G companies contributing to the energy transition? A novel analytical framework for assessing sustainability strategies**

Oil and gas (O&G) companies are progressively developing and adopting sustainability strategies in response to regulatory and market pressures embedded in the energy transition process. The UN's Sustainability Development Goals (SDGs) are strongly linked to energy transitions and key to achieving successful sustainability strategies. A novel analytical framework to evaluate sustainability strategies is proposed and applied to the case study of Petronor, a refining company in the Basque Country (Muskiz, Bizkaia). The analysis helps to assess how O&G companies contribute to the energy transition by focusing on the SDGs. This first application of this framework suggests that a comprehensive understanding of an O&G company's sustainability efforts is needed to fully evaluate its role in the energy transition.

Las empresas de petróleo y gas (O&G) están desarrollando y adoptando progresivamente estrategias de sostenibilidad en respuesta a las presiones regulatorias y de mercado contempladas en el proceso de transición energética. Los Objetivos de Desarrollo Sostenible (ODS) de la ONU están estrechamente vinculados a las transiciones energéticas y son clave para lograr estrategias de sostenibilidad exitosas. Se propone un novedoso marco analítico para evaluar estrategias de sostenibilidad y se aplica al caso de estudio de Petronor, una empresa de refino del País Vasco (Muskiz, Bizkaia). El análisis ayuda a evaluar cómo las empresas de O&G contribuyen a la transición energética al centrarse en los ODS. Esta primera aplicación de este marco sugiere que se necesita una comprensión integral de los esfuerzos de sustentabilidad de una empresa de O&G para evaluar completamente su papel en la transición energética.

Petrolio- eta gas-enpresak (O&G) iraunkortasun-estrategiak garatzen eta hartzen ari dira pixkanaka, trantsizio energetikoaren prozesuan aurreikusitako erregulazio- eta merkatu-presioei erantzuteko. NBEren Garapen Iraunkorreko Helburuak (GIH) oso lotuta daude trantsizio energetikoekin, eta funtsezkoak dira iraunkortasun-estrategia arrakastatsuak lortzeko. Esparru analitiko berri bat proposatzen da iraunkortasun-estrategiak ebaluatzeko, eta Petronorren azterketari aplikatzen zaio, Euskal Autonomia Erkidegoko fintze-enpresa bati (Muskiz, Bizkaia). Analisiak laguntzen du ebaluatzen O&G enpresek nola laguntzen duten trantsizio energetikoan, GIHetan zentratzen direnean. Esparru horren lehen aplikazio horrek iradokitzen du beharrezkoa dela osorik ulertzea O&Gko enpresa batek egiten dituen iraunkortasun-ahaleginak, trantsizio energetikoan betetzen duen rola erabat ebaluatu ahal izateko.

* Spanish version available at https:/euskadi.eus/ekonomiaz.

Jaime Menéndez Sánchez
Orkestra-Basque Institute of Competitiveness and Deusto Business School (University of Deusto) / University of the Basque Country (UPV/EHU)

Jorge Fernández Gómez
Orkestra-Basque Institute of Competitiveness and Deusto Business School (University of Deusto)

Andrés Araujo de la Mata
University of the Basque Country (UPV/EHU), GPAC

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1. INTRODUCTION

A common challenge in the energy transition processes is reducing greenhouse gas emissions from the combustion of fossil fuels (Grubler, 2012; Clews 2016; IEA, 2020a), positioning oil and gas (O&G) companies under increasing market and regulatory pressure to adapt their businesses and processes. This adaptation will have profound environmental, economic and social implications, especially in locations where O&G companies account for a relevant share of economic activity.

These factors suggest a trade-off between moving fast towards a low- or zero net-emissions economy and the development of sound sustainability strategies by the O&G companies. Any approach to sustainability can hardly ignore the existing call to businesses around the globe to integrate the United Nations' Sustainable Development Goals (SDGs) into their strategies (Kingo, n.d.; UN Global Compact, n.d.; SDG Compass, n.d.). Identifying those SDGs that are most relevant to an O&G company may be a useful first step in building robust sustainability strategies.

The aim of this paper is to develop a novel analytical framework that helps to identify, classify and arrange in order of importance the activities of an O&G company regarding their contribution to the SDGs, by linking them to low-carbon technologies. In order to do so, this work addresses the approaches to energy-related SDGs by international organizations like the United Nations Development Programme (UNDP) or the International Energy Agency (IEA). This purpose is guided by the following research question: *how can an O&G company contribute to the energy transition by implementing a sustainability strategy?*

As a first application of this tool, the analysis in this article focuses on a specific case study around Petronor, the only refinery in the Basque Country.

This paper is structured as follows. Section 2 conducts a non-systematic literature review on the relationship between energy transitions and the SDGs and how O&G businesses adapt to the changing environment. Section 3 describes the proposed analytical framework regarding the fulfilment of the SDGs. In Section 4, Petronor's sustainability strategy and related activities are assessed under this framework. The last section presents conclusions and avenues for further research.

2. LITERATURE REVIEW

2.1. Relationship between energy transitions and the SDGs

Although no universally accepted definition exists, the concept of energy transition is generally understood in the academic literature as a shift away from low-cost, centralized, mostly fossil-based energy systems or the change to a more sustainable energy and economic system (Verbong & Loorbach, 2012).

It is a process that involves transformation along many dimensions towards meeting economic, social and environmental goals, implying changes in the generation and use of energy and other resources for production processes or final consumption. It is also characterized by technological and institutional changes, innovation dynamics and other societal and economic trends (e.g., regarding urbanization, population, interactions between various stakeholders, social issues, politics and institutions, etc.) (Grubler, 2012; Araújo, 2014; Li *et al.*, 2015; Defeuilley, 2019; Lee and Yang, 2019; Sorman *et al.*, 2020).

The concept of sustainability lies now at the heart of the energy transition. This arises from the view that sustainable development means overcoming several energy challenges, related to issues such as emissions and climate change, air pollution, energy security, energy poverty, water, food or the use of land and forests (McCollum *et al.*, 2011; Bazilian *et al.*, 2011). The synergies between objectives such as tackling climate change, increasing energy security and reducing air pollution and related health impacts lead to the need to take an integrated perspective and approach to designing and implementing energy and climate change policies (McCollum *et al.*, 2011; Waage *et al.*, 2015) and assessing energy transition pathways (Hammond *et al.*, 2013; Barton *et al.*, 2018; Child *et al.*, 2018).

The SDGs were developed to guide changes in the world's economies and societies, including a response to global energy and climate change challenges. The academia has studied the relationship between the various SDGs and found that the economic, social and environmental targets are deeply intertwined and can be considered an indivisible whole, with positive and significant cross impacts (Griggs *et al.*, 2013; Griggs *et al.*, 2014; Le Blanc, 2015; Waage *et al.*, 2015; Stafford-Smith *et al.*, 2017; Nilsson *et al.*, 2018). Furthermore, significant benefits can accrue from integrated policies and strategies that appropriately account for synergies between SDGs (Scharlemann *et al.*, 2020).

The relationship between energy- and climate-change-related goals and other SDGs is also being studied by scholars. von Stechow *et al.* (2015; 2016), Jakob and Steckel (2016) and Riahi *et al.* (2017) address the relationships and trade-offs between climate-change policies and non-climate SDGs across variables such as air pollution, energy security, land and water use, energy poverty or employment. Fuso Nerini *et al.* (2017) review the synergies and trade-offs between SDG 7 (affordable and clean energy) and the other SDGs, arguing that energy systems are key to social and economic development and have a decisive effect on the delivery of all other SDGs.

In a similar fashion, McCollum *et al.* (2018) show that positive interactions between SDG 7 and the other SDGs outweigh the negative ones, which leads to the conclusion that energy policy must be designed in a way that accounts for the effects and potential spillovers across other sustainability dimensions.

2.2. **O&G strategies within the energy transition**

The academic literature has scrutinized the ongoing shifts in the strategies of O&G companies resulting from growing pressure to increase their environmental sustainability from different angles and in a heterogeneous way. Different attempts to develop new business models can be identified in the decades following the 1973 oil crisis. Although many of them were unsuccessful, they are relevant precedents and had an influence on national energy policies (Boon, 2019).

Weijermars *et al.* (2014) identify the rise of hydrocarbon extraction costs as an incentive for accelerating the transition to renewable energy investments in recent decades. However, in the last few years many other several factors appear to be accelerating the changes in O&G company strategies. According to Csomós (2014), investments in the renewable energy sector made by the largest public oil companies may respond to reputational factors and to advertising strategies and their perception about the extent to which market and demand forecasts support the continuity of conventional O&G business models. Additionally, García *et al.* (2014) claim that a differentiating factor for energy firms' approach to sustainability could be their ability to tackle social concerns beyond climate change, for instance by engaging with the local community to build entrepreneurial skills.

More recently, a growing number of authors have focused on the identification of O&G activities in the evolving energy landscape. Pickl (2018) classifies the major O&G companies into «renewable leaders» or «laggards» depending on their strategies regarding investments in renewable energy. According to Peng Yun *et al.* (2019) these strategies may also be driven by a shift towards gas production, or collaboration with peers. These divergences may be clearer among oil majors' strategies in Europe and the US and have been illustrated as a 'trans-Atlantic divide' (Andreasson, 2018), which may also apply to a circular economy perspective (de Selliers & Spataru, 2020).

Despite recent research, there is still a thin body of academic literature focusing on this issue and heterogeneous approaches to characterizing the companies' strategies are taken. This may be justified on the basis of the novelty of the strategies and the consequent lack of data to evaluate their success (Zhong & Bazilian, 2018). This 'under-examination' of O&G company strategies in the literature applies particularly to state-owned companies and developing countries (Chaiyapa *et al.*, 2018).

This leads to complement the academic knowledge with 'grey' literature, since some relevant international organizations have paid attention in recent years to the challenge of decarbonizing the O&G sector. For example, IEA (2020a) questions whether O&G companies should be viewed not only as part of the climate change problem but also as part of the solution, while UNDP *et al.* (2017) focus on the SDGs.

Some authors have taken this last approach and have tried to relate the SDGs and the O&G sector (Ekiugbo and Papanagnou, 2017; Williams, 2018; Hamzah, 2019). However, a deeper level of analysis would be desirable, given the growing importance of sustainable development approaches.

3. METHODOLOGY AND DEVELOPMENT OF AN ANALYTICAL FRAMEWORK

3.1. Case study methodology

The aim of this paper is to introduce an analytical framework that helps to improve the understanding about how an O&G company contributes to SDGs. For this purpose, the methodology of case study research is chosen (Villarreal, 2016), given the absence of well-defined theoretical frameworks and as a prior step before more precise further research.

Proponents of this methodology argue that case studies that focus on single settings like corporations do actually cover a variety of items that, via the study of repeated observations, can lead to generalizations (Eisenhardt, 1989, 1991; Dyer & Wilkins, 1991).

The selection of cases should focus on situations with transparently observable interest (Eisenhardt, 1989) and, in single-case studies, as is the case of this article, the object of analysis should be considered to have enough importance and significance to be critical (Villarreal, 2016). The purpose of this work fits well within this approach.

Taking this into account, Petronor (Petróleos del Norte, S.A.) has been chosen as pilot case for introducing and testing the proposed analytical framework for a number of reasons that highlight its relevance as object of study. First, it is the only refinery in the Basque Country, it accounts for a significant share of the economic activity in the region and will play a critical role in the region's energy transition.

Moreover, Petronor's main shareholder is Repsol (with a stake of 85.98%) (PWC, 2020), and the company is fully integrated into its downstream business as one of the Repsol group's five refineries in Spain. The fact that Repsol became in 2017 the first O&G company to commit to achieving net-zero emissions by 2050 (Repsol, 2019a; OGCI, n.d.) increases the interest of studying the case of Petronor. As part of Repsol's sustainability strategy, Petronor is attracting to the Basque Country key innovative decarbonisation projects and initiatives.

3.1.1. ***Sustainability actions as units of analysis***

According to Villarreal (2016), the «unit of analysis» within each case study must be clearly defined in order to trace the boundaries and the core of the research work. In this article, the analysis of Petronor's sustainability strategy focuses on its «sustainability actions», which are treated as units of analysis. The advantage of centring the analysis on sustainability actions is that they drive the company's approach to fulfilling the SDGs along specific, detailed paths.

Petronor's annual Sustainability Plans (Petronor, 2016; 2017; 2018; 2019a; 2020a) are used as primary information sources in this study. Each of these documents identifies a series of detailed activities, labelled as «actions» by the company, that conform the firm's sustainability strategy.

The SDGs appeared for the first time in Petronor's Sustainability Plans in 2016, mentioned in a general way. In 2017, the most relevant SDGs for Petronor were identified, but still not related to specific sustainability actions by the company. Since 2018, however, Petronor's Sustainability Plans have related each sustainability action to selected SDGs, according to the company's own view.

At the same time sustainability actions are the unit of analysis of the case study of Petronor, the SDGs represent the boundaries of the study. The relevant SDGs, chosen by the company, reflect Petronor's sustainability priorities, as described in the Sustainability Plans[1] and other corporate documents (both Petronor's and Repsol's).

In line with Repsol's corporate approach to the SDGs, Petronor identifies seven key SDGs and classifies them into a primary and a secondary focus group (Repsol, 2019b; 2019c; Petronor, 2019a; 2020a). This work is centred on the primary group, which is directly related to the energy transition and the company's response to the climate change challenges (specifically SDGs and 7 and 13), but also to working conditions and economic growth (SDG 8). This identification serves as the delimitation of the boundaries of the analysis, following Villarreal (2016).

3.2. **Development of a framework for analysing the contribution to the SDGs**

In this subsection, two different frameworks for analysis are introduced. The combination of both frameworks constitutes a proposal of a novel approach to assess the sustainability strategy of O&G companies (see Subsection 3.2.3).

The first one describes the channels of contribution to the SDGs by companies in the O&G sector and was developed by the United Nations Development Programme (UNDP) and other organizations (see Subsection 3.2.1). This is complemented with the use of a second analytical framework based on a database on new low-carbon technologies developed by the International Energy Agency (IEA) (see Subsection 3.2.2).

The resulting process of analysis may be seen as an approximation to the «case study protocol», advisable for single case studies (Villarreal, 2016). Here, the proposed framework aims to standardize the application to a case study, as it is based on external information, is replicable and includes a pilot case (Petronor). The final stage of the analysis seeks to find generalizations and present new, perhaps «frame-breaking», insights, as Eisenhardt (1991) claims.

*3.2.1. **The UNDP Atlas***

The first framework applied in the analysis follows UNDP *et al.* (2017). This identifies different paths for an O&G company to address and engage with the SDGs (called «areas of contribution to sustainability» in this article), either by integrating a targeted SDG into the company's core business or by collaborating with other stakeholders in supporting sustainability efforts. It is conceived as an «Atlas» or tool to be used by businesses to better understand their sustainability targets. Following this, this report is referred to here as «the Atlas».

The Atlas sets a series of steps for companies in the O&G sector undertaking a thorough analysis of how to address the SDGs, including (1) the identification of the most relevant SDGs to the company's activities, (2) engaging with stakeholders, par-

[1] In the case of Repsol, this refers to the Global Sustainability Plans.

ticularly governments, to identify overlapping development priorities and (3) collaborating with stakeholders to develop a shared understanding of the company's role in supporting the SDGs.

Step 1 depends on a company's own initiative to relate its activities to SDGs. Petronor has done so in its Sustainability Plans from 2018 to 2020. Such correspondence is used in this work as the starting point for using the Atlas to characterize Petronor's sustainability strategy (as explained in Subsection 3.1.1).

For example, if in one of Petronor's Sustainability Plans a given sustainability action is related to SDG 7, then this action is classified into one of the areas of contribution to sustainability that UNDP *et al.* (2017) establish for this SDG. It may also fit in areas of contribution within other SDGs. This way, the analysis consists of finding the areas of contribution within the Atlas where each of the sustainability actions by Petronor would best fit in.

Applying the Atlas to Petronor's sustainability actions helps to identify the specific channels through which each action contributes to the SDGs, thus reinforcing the company's reasoning behind linking individual sustainability actions with certain SDGs. It also facilitates classifying other activities by the company that were not included in the Sustainability Plans but appear in other sources. Hence, this framework helps to identify of gaps or missing pieces in a company's sustainability approach (according to the SDGs) and facilitates the replicability of the analysis in different case studies.

*3.2.2. **The IEA's ETP-CET Guide***

The second framework follows the approach to the SDGs described in IEA (2020b). According to this, SDGs 3, 7 and 13 are critical for reaching energy-related and sustainability goals and, in order to meet them, the evolution of the (global) energy sector should be guided by the so-called Sustainable Development Scenario (SDS).

The SDS is the spotlight of the IEA's Energy Technology Perspectives (ETP) reports (IEA, 2020c; 2020d), which highlight the importance of technology innovation in meeting sustainability goals. The IEA has developed an interactive database called «ETP Clean Energy Technology Guide» (IEA, 2020e), referred to in this paper as «ETP-CET Guide», which includes information on the level of maturity of up to 433 technology solutions (in this paper, referred as «key technologies») that are applicable in different segments of the energy system and that contribute to achieving the goal of net-zero emissions in 2070 embedded in the SDS.

The purpose of applying this framework in this study is to identify whether there are key technologies included in the ETP-CET Guide that may be linked to Petronor's sustainability actions. By relating key technologies and sustainability actions (which, in turn, are related to the SDGs), the contribution by Petronor to the innovation process can be assessed, by looking at two specific parameters assigned by the ETP-CET Guide to each technology:

- The Technology Readiness Level (TRL), which uses IEA's own 1-11 scale.
- The «importance for net-zero emissions», which describes the IEA's view regarding the market share of that technology in the net-zero emissions SDS in 2070. The ETP-CET Guide divides the list into three groups, depending on their forecasted role in the 2070 SDS scenario: «very high», «high» and «moderate» importance. This variable refers to an estimated market share, so a «lower importance» score does not mean that a technology is less or not at all needed to achieve the SDS.

These two parameters are used to define a relevance order for the various key technologies associated to the sustainability strategy of Petronor, based on two criteria.

The first criterion is that the higher the TRL is, the less time it takes for the key technology (hence, the sustainability action) to contribute to the targeted SDGs and, therefore, a higher relevance order should be set.

The second criterion is that the more important the key technology is for net-zero emissions according to IEA's view, the more aligned it is with global technology trends and the higher relevance order it should have. This is consistent with the idea that, from a potential return-on-investment point of view, it would be preferable for a company to develop or adopt a technology that is applied in larger markets and value chains where innovation spillovers could take place (Acemoglu & Linn, 2004; Nieto & Quevedo, 2005; van Praag & Versloot, 2007).

3.2.3. ***Combining the two analytical frameworks***

By combining the two frameworks described above (based respectively on the Atlas and on the ETP-CET Guide), an analytical tool can be developed to evaluate how the actions of an O&G company contribute to the SDGs. The combination of both frameworks requires to identify the SDGs that can be analysed, to define how the process of analysis is structured and, additionally, to define codes for ease of analysis.

Limitation of which SDGs the analysis can focus on

In order to delimit the number of SDGs that can be addressed in this work, two approaches are considered:

- UNDP *et al.* (2017) cover all the SDGs, but each company chooses what the main goals for its business priorities are. As shown in Subsection 3.1.1, Petronor's sustainability strategy is focused on Goals 7, 8 and 13.
- As described in Subsection 3.2.2, the ETP-CET Guide follows the IEA's SDS, which focuses on Goals 3, 7 and 13.

This means that a common approach linking both frameworks should be based on SDGs 7 and 13, as SDGs 3 and 8 are not addressed by the two of them. The main limitation of this tool is then related to the energy-centred approach of the IEA's SDS. Its main advantage is that it complements the analysis of the energy dimension of SDGs with a technological focus that appears to be key to define the path to a net-zero emissions horizon.

Structure of the process of analysis

The process of studying Petronor's sustainability strategy is based on three main blocks of analysis:

- Sustainability actions. As defined in 3.1.1, these are each of the specific activities that make up the company's Sustainability Plans. In Petronor (2018; 2019a; 2020a), each sustainability action targets specific SDGs. Sustainability actions are the starting point of the analysis.
- Areas of contribution to sustainability. These are the different paths that UNDP *et al.* (2017) identify for contributing to each SDG (as described in 3.2.1) and are used here to classify the sustainability actions, using the authors' judgment. This step validates the sustainability actions and helps to identify additional relevant ones not included in the company's Sustainability Plans.
- Key technologies. These are the various technologies that are listed in the ETP-CET Guide (as explained in 3.2.2). They are used here to establish a technological linkage for each sustainability action, where this is possible. This helps to assign each sustainability action a TRL score and an «importance for net-zero emissions» category.

Two more items are introduced in the analysis to facilitate the discussion of the results. These two additional pieces are outputs of the analysis tool.

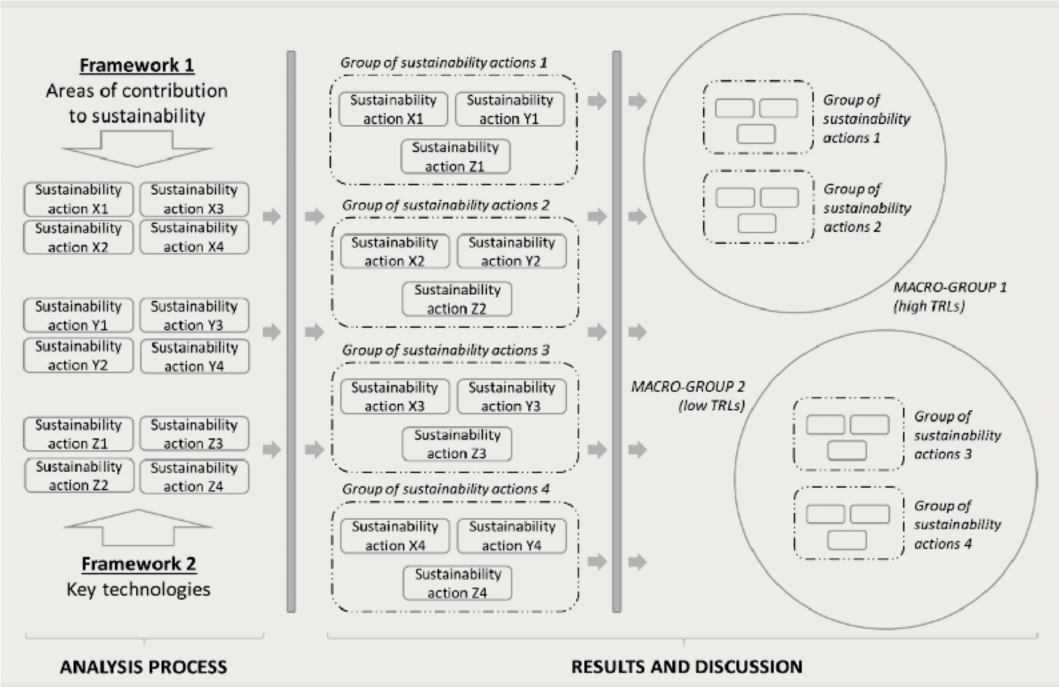
- Groups of sustainability actions. Based on the linkages between sustainability actions and key technologies, these groups gather different sustainability actions (once they are associated with key technologies) when they share a same purpose[2]. When the group includes more than one sustainability action or key technology, the criteria used to characterize each group is to identify it by the highest TRL within it, as well as its corresponding «importance for net-zero emissions» score. This assumes that the most advanced technology in the innovation ladder is the leading technology within the group. On the basis of the assigned TRLs, firstly, and of the importance for net-zero emissions, secondly, the resulting groups of sustainability actions are ordered hierarchically from highest to lowest relevance.
- Macro-groups. Based on the resulting order of the groups of sustainability actions, those that show proximity of TRLs are gathered in larger groups called here macro-groups. These help to characterize the main results in a more simplified manner and are used to draw generalizations (in line with the case study methodology) and derive conclusions.

Figure 1 depicts the relationship between these five pieces of analysis that, together, help to conduct the analysis within the proposed framework. As it can be seen, the analysis starts with sustainability actions (given by the company's sources)

[2] For example, various different technologies for producing hydrogen from electrolysis, could be gathered under a common group called «electrolysis».

and ends by organizing them in large macro-groups, from which general conclusions may arise. This tool is applied to the specific case of Petronor in Section 4. It is important to underline the replicability of this approach to analyse this and other case studies of O&G companies' contribution to SDGs.

Figure 1. **EXAMPLE OF THE PROPOSED FRAMEWORK FOR ANALYSING THE TECHNOLOGICAL CONTRIBUTION TO SDGS BY AN O&G COMPANY**



Source: own elaboration.

Nomenclature (codes)

In order to facilitate the treatment of sustainability actions as the basic units of analysis, each sustainability action is labelled with a code.

Sustainability actions related by Petronor to SDGs 7 and 13 are assigned codes «A7» and «A13», respectively, and are ordered chronologically in the way they appear in Petronor's Sustainability Plans (i.e., A7.1, A7.2, etc.). Additionally, actions that are related to other SDGs by Petronor but that could conceptually be linked to SDGs 7 and 13 are assigned code «A0» (resulting in specific codes A0.1, A0.2, etc.). Relating «A0» actions to SDGs 7 and 13 is carried out under the authors' own judgment, as described in Section 4.

Finally, the review of different corporate documents (both Repsol's and Petronor's) yielded the identification of other activities carried out by Petronor that contribute to sustainability, as defined in the Atlas, but that are not included in the companies' Sustainability Plans. These additional activities are assigned the letter «B» and classified within SDG 7 (actions B7.1, B7.2, etc.) or 13 (actions B13.1, B13.2, etc.). Their inclusion in the analysis is also based on the authors' own judgment on the basis of the discussion in Section 4.

4. ANALYSIS OF THE CONTRIBUTION TO SDGS BY PETRONOR

4.1. Application of the proposed analytical framework to the case of Petronor

In this section, the framework described previously is applied to the case of Petronor's approach regarding sustainability, which follows that of its parent company, Repsol. As previously stated, the analysis carried out in this paper focuses on SDGs 7 and 13 and, accordingly, Petronor's sustainability actions (from its Sustainability Plans) are assigned codes A7.X, A.13.X or A0.X. Table 1 presents the list of identified sustainability actions by Petronor in 2018-2020.

Table 1. **SUSTAINABILITY ACTIONS CLASSIFIED BY PETRONOR AS CONTRIBUTIONS TO SDGS 7 AND 13 AND TO OTHER SDGS BUT WITH STRONG LINKS WITH SDGS 7 AND 13**

2018	2019	2020
SDG 7 (Code A7.X)		
	A7.1. Execute investments in refinery equipment and processes to reduce CO_2 emissions (repeated in A13.3) A7.2. Organize informational and awareness activities focused on energy sustainability and accessibility	A7.3. Optimize the process for obtaining hydrogen (repeated in A13.7)
SDG 13 (Code A13.X)		
A13.1. Implement measures to improve energy efficiency and reduce greenhouse gas emissions A13.2. Participate in international verification processes for the analysis of greenhouse gas emissions	A13.3. (same as A7.1 for SDG 7). A13.4. Participate in international verification processes for the analysis of greenhouse gas emissions	A13.5. Reduce the waste generated during stoppages and sent to landfill sites A13.6. Promote voluntary work in schools related to environmental issues A13.7. (same as A7.3 for SDG 7)
2018	2019	2020
Other SDGs (Code A0.X)		
A0.1. Launch innovative activities from Petronor Innovation (a Petronor subsidiary)	A0.2. Start operating the pilot project «Smart aggregator for generation and consumption» at Petronor's Training Centre in Somorrostro (Bizkaia)	A0.3. Improve energy efficiency in acid water treatment A0.4. Promote renewable power generation and km 0 consumption

Source: own elaboration based on Petronor (2018; 2019a; 2020a).

In the same way, additional activities that can be classified as sustainability actions (but not included in the Sustainability Plans) are assigned codes B7.X or B13.X, as shown in Table 2.

Table 2. **SUSTAINABILITY ACTIONS BY PETRONOR THAT CAN CONTRIBUTE TO SDG 7 AND SDG 13 BUT NOT INCLUDED IN PETRONOR'S SUSTAINABILITY PLANS**

Additional sustainability actions	Assigned codes
Creation of Edinor (developer of distributed generation and energy communities)	B7.1
Agreement with natural gas distributor Nortegas to supply CNG for transportation	B7.2
Production of synthetic fuels with hydrogen production and carbon capture	B7.3
Pyrolysis treatment plant	B7.4
Project eMovLab (electric mobility)	B7.5
Think Tank #VEHICLES7YFN (on sustainable, connected and autonomous mobility)	B7.6
Commitment to be a net-zero emissions company by 2050	B13.1
Collaboration with the RESET-KLIMATEK project (adaptation of energy infrastructures to climate change)	B13.2
Collaboration with agents in the Basque science and technology network (for digitalization and energy storage technologies)	B13.3
Involvement in the EIC (Energy Intelligence Center, a R&D and knowledge hub) and Basque Hydrogen Corridor projects	B13.4

Source: own elaboration based on Petronor (2018; 2019a; 2020a).

In the next two subsections, Petronor's contributions to SDGs 7 and 13 are assessed by using the analytical framework developed in Section 3.

4.2. **Petronor's contribution to SDG 7 («Ensure access to affordable, reliable, sustainable and modern energy for all»)**

Table 3 presents the full list of Petronor's sustainability actions that contribute to SDG 7 (included in Tables 1 and 2), classified by area of contribution (as defined by the UNDP Atlas; see the first column of the table).

Each of the sustainability actions presented in the second column of the table is assigned a corresponding key technology (within the ETP-CET Guide), shown in the third column. The fourth and fifth columns of the table present, respectively, the technology's corresponding TRL and its «importance for net-zero emissions», also according to the ETP-CET Guide.

Table 3. **SUSTAINABILITY ACTIONS BY PETRONOR CONTRIBUTING TO SDG 7**

Main areas of contribution to SDG 7, as defined by UNDP *et al.* (2017)	Sustainability actions (codes in Tables 1 and 2)	Related technology from the ETP-CET Guide	TRL	Importance for net-zero emissions
Improve access to energy services through shared infrastructure	A0.1 A0.2	Open automated demand response	7	High
	A0.1 A0.4	Direct current microgrid system	7	High
	B7.1	Virtual net metering - Community Scale Solar	8	Very high
		Transactive energy	4	Moderate
Grow the share of natural gas in the energy mix[a]	B7.2	Hydrogen blending in natural gas network	6-7	Moderate
Main areas of contribution to SDG 7, as defined by UNDP *et al.* (2017)	Sustainability actions (codes in Tables 1 and 2)	Related technology from the ETP-CET Guide	TRL	Importance for net-zero emissions
Increase the share of alternative energies and technologies in the global energy mix	B7.3	Liquid fuels from hydrogen and CO_2	5-7	Very high
		Electrolysis (alkaline)	9	Very high
		Electrolysis (polymer electrolyte membrane)	8	Very high
		Electrolysis (solid oxide electrolyser cell)	6-7	Moderate
		Gasification and hydrogen enhancement and Fischer-Tropsch	3-4	High
		Hydrogen refuelling station	9	Moderate
	B7.4	New recycling techniques with reduced downcycling	9	Moderate
Improve energy efficiency in operation and production	A7.1	Fluid catalytic cracker in combination with post-combustion capture or oxy-fuelling capture	5	Moderate
	A7.3	Hydrogen production at refinery	3-4	Moderate
	A0.3	N/A	-	-
An integrated, multi-stakeholder approach to energy poverty[b]	A7.2 A0.1 B7.5 B7.6	Battery electric vehicle / Fast charging	9 / 8	Very high / High

Source: own elaboration. Note: N/A = not applicable. [a] It is interpreted that the existence of natural gas infrastructure will pave the way for the consumption of hydrogen in a sustainable scenario. [b] In this analysis, the idea of «energy poverty» is interpreted broadly, in the sense of «energy social challenges». See subsection 4.2.5.

Although Table 3 is intended to be self-explanatory, some details are clarified in each area of contribution to SDG 7, especially regarding actions labelled with letter «B» (not included in the Sustainability Plans) or those that are not included in the analysis due to a lack of linkage with key technologies from the ETP-CET Guide.

Each of the main areas of contribution (first column of Table 3) is then discussed in more detail.

*4.2.1. **Improve access to energy services through shared infrastructure***

Sustainability action B7.1 implies the creation in 2020 of a Petronor subsidiary called Edinor to develop distributed generation and energy community systems (UNEF, n.d.; Petronor, 2020b). Regarding actions A0.1 and A0.4, which introduce microgrids into the sustainability strategy, it should be noted that these are infrastructures that can have more designs than the «direct current» model included in the ETP-CET Guide (see Table 3) (Arif & Hasan, 2018).

*4.2.2. **Grow the share of natural gas in the energy mix***

Sustainability action B7.2 encompasses an agreement signed in 2020 between Repsol and Nortegas Green Energy Solutions (part of Nortegas, a gas distribution company) to promote compressed natural gas (CNG) supply for transportation through the Repsol group's network of petrol stations (Nortegas, 2020; Petronor, 2020c).

None of the key technologies cover CNG supply for transportation, but this action can be related to the technology «hydrogen blending in natural gas network»[3] since petrol stations are a basic element for hydrogen end-use in road transportation and, therefore, part of the infrastructure required for hydrogen distribution within the natural gas network. Both Nortegas (Nortegas, n.d.) and Petronor have interest in hydrogen technologies (see next item).

*4.2.3. **Increase the share of alternative energies and technologies in the global energy mix***

Sustainability action B7.3 represents Petronor's plans to develop a major project for a synthetic fuels (efuels) plant based on hydrogen production and carbon capture in the port of Bilbao[4] (Petronor, 2020d; 2020e; BH_2C, 2020).

Additionally, sustainability action B7.4 represents a second large project announced by Petronor for the development of a pyrolysis treatment plant to convert solid urban waste into biogas in order to partly substitute the natural gas consumed by the refinery[5] (Petronor, 2020f).

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[3] As indicated in Table 3, it is interpreted that the existence of natural gas infrastructure will pave the way for the consumption of hydrogen in a sustainable scenario.

[4] Together, the Petronor's efuels plant and electrolysis facilities imply a 58.6 M€ investment. A production of fifty daily barrels is expected to be reached by 2024.

[5] This represents a 21.3 M€ investment.

4.2.4. ***Improve energy efficiency in operation and production***

Sustainability action A0.3 aims to improve energy efficiency in acid water treatment, but no corresponding key technology could be identified. This area of contribution is related to actions A13.1 and A13.5 (see Subsection 4.3).

4.2.5. ***An integrated, multi-stakeholder approach to energy social challenges***[6]

Energy social challenges can include a large variety of issues, from energy poverty, lack of access to essential services, premature mortality due to air pollution, etc. Petronor's sustainability actions focused on transportation issues are related to some of these challenges and, at the same time, have an evident multi-stakeholder dimension.

This is the case of various initiatives. First, the eMovLab is one of the company's main R&D projects (labelled as sustainability action B7.5), Petronor is the leader of this consortium of different actors in the industrial and technological value chains in mobility in the Basque Country (Petronor, 2020g). Second, Petronor participated in a series of multi-stakeholder working groups focused on analysing the short-term evolution of mobility promoted by Spanish ICT business association under the brand Think Tank #VEHICLES7YFN (Ametic, 2019). These complement Petronor's collaboration with the City Council of Bilbao in the organisation of a Sustainable Mobility Congress and an eco-rally for electric vehicles (SUM Bilbao, 2019; FIA-ERRC, 2019) or Petronor Innovación's (a subsidiary of Petronor) work on sustainable mobility (respectively actions A7.2 and A0.1).

This results in a large and varied coverage of issues and stakeholders, among which company Ibil[7] stands out as a key Petronor stakeholder, owing to its close linkage to Repsol and its transversal presence in the aforementioned actions, sharing Repsol's and Petronor's goals on electric mobility (Petronor, 2020h). This is the reason for linking these sustainability actions to the «battery electric vehicle» and «fast charging» key (generic) technologies.

4.3. **Petronor's contribution to SDG 13 («Take urgent action to combat climate change and its impacts»)**

Table 4 presents the full list of Petronor's sustainability actions that contribute to SDG 13 (second column), classified by area of contribution in the UNDP Atlas (first column) and with the associated technology within the ETP-CET Guide (third column) and its related TRL and «importance for net-zero emissions» level, also according to the ETP-CET Guide (columns four and five). As is the case of Table 3 in the previous section, the aim of Table 4 is to be self-explanatory, but some details are clarified in each area of contribution to SDG 13.

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[6] In UNDP *et al.* (2017) this contribution area originally refers to «energy poverty», instead of «social challenges». The analysis in this article adopts a broader perspective.

[7] Ibil is a technological company founded by Repsol and the Basque Government's energy agency EVE with the purpose of developing electric vehicles charging technology and infrastructure.

Table 4. **SUSTAINABILITY ACTIONS BY PETRONOR CONTRIBUTING TO SDG 13**

Main areas of contribution to SDG 7, as defined by UNDP et al. (2017)	Sustainability actions (codes in Tables 1 and 2)	Related technology from the ETP-CET Guide	TRL	Importance for net-zero emissions
Plan strategically for a net-zero emissions future Self-assess carbon resiliency	B13.1	N/A	-	-
Strengthen resilience and adaptive capacity to climate change impacts	A13.6 B13.2	N/A	-	-
Mitigate emissions within oil and gas operations	A13.1	N/A	-	-
	A13.5	Waste gasification	3-5	Moderate
	A13.3 (same as A7.1) A13.7 (same as A7.3)	Fluid catalytic cracker in combination with post-combustion capture or oxy-fuelling capture and hydrogen production at refinery (see Table 3)	-	-
Partner in research and development and education outreach	A13.2 A13.4	N/A	-	-
	B7.3 B7.4	Various synthetic fuels production and electrolysis technologies (see Table 3)	-	-
	B13.3	N/A	-	-
Support effective policy measures	B13.4	N/A	-	-
Help consumers lower their emissions	A0.1 B7.1 B7.3 B7.5 B7.6	Various low-emissions technologies like demand response; microgrids; energy communities; production of synthetic fuels and hydrogen; electric vehicle; etc. (see Table 3)	-	-

Source: own elaboration. Note: N/A = not applicable.

4.3.1. ***Plan strategically for a net-zero emissions future / Self-assess carbon resiliency***

Sustainability action B13.1 is a global corporate target that follows the fact that, in 2017, Repsol became the first O&G company to commit to achieving net-zero emissions by 2050 (Repsol, 2019a; OGCI, n.d.). Every downstream unit within the group must contribute to this strategic planning, including Petronor. At the same time, this necessarily involves the «Self-assess carbon resiliency» area of contribution by assessing investments, decision-making, risk evaluation and adaptation strategies and processes regarding climate change impact on business.

4.3.2. ***Strengthen resilience and adaptive capacity to climate change impacts***

Sustainability action B13.2 refers to a programme called Klimatek, supported by the Basque Government's Environment Agency (Ihobe), that analysed the potential effects of climate change in the Basque Country. Within this programme, project RESET focused on the resilience of critical energy infrastructure (Ihobe, 2020; Basque Government, 2020). Due to its geographical position, Petronor participated in the project and both the refinery and other O&G infrastructure were included in the list of critical energy assets.

Additionally, Petronor's action A13.6 also addresses the company's facilities' environmental footprint through nature-based solutions such as the reforestation of degraded land. No key technologies could be identified for both sustainability actions.

4.3.3. ***Mitigate emissions within oil and gas operations***

Sustainable action A13.1 seeks the certification of its energy management system under standard ISO 50.001:2011[8] in order to improve energy efficiency and reduce emissions. This goes together with reducing waste from operations that is sent to landfill sites (action A13.5). None of them could be specifically linked to a key technology; A13.5 may be related to «waste gasification», but only if oriented to converting unrecyclable plastic waste into electricity or hydrogen[9].

4.3.4. ***Further partnerships and synergies***

«Partner in research and development and education outreach», «Support effective policy measures» and «Help consumers lower their emissions» are the remaining areas of contribution to SDG 13. Sustainability actions that fit into these areas have in common a partnering and collaborative approach rather than technological, so no linkages with key technologies could be found.

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[8] This has been replaced by ISO 50001:2018 (ISO, n.d.).

[9] See the Waste2tricity example in Fuel Cells Bulletin (2020).

This is the case of sustainability actions A13.2 and A13.4, which consist of participating in international verification activities with recognized foreign organisations and laboratories to contrast the rigour of Petronor's greenhouse gas analysis.

Other actions also show synergies with areas of contribution to SDG 7. For example, sustainability action B13.3 represents Petronor's collaborations with agents from the Basque network of science and technology (SPRI, n.d) to promote the digitalization of the refinery's operations or foster energy storage for mobility (Tecnalia, 2018; Cidetec, 2018; Petronor, 2019b; n.d.).

In particular, sustainability action B13.4 involves Petronor's collaboration with the Provincial Council of Biscay in the projected Energy Intelligence Center (EIC), a technological R&D hub that will specialize in innovative technologies for hydrogen, smart grids, wind generation and O&G. This support is partly driven by the company's leadership of the hydrogen area, which is a milestone in the development of the so-called Basque Hydrogen Corridor and a new sustainable mobility value chain in the Basque Country (BH_2C, 2020). But also, by its announced intention to relocate its corporate headquarters and its subsidiary Edinor at the EIC facilities (Petronor, 2020i).

Since many other industrial companies from the aforementioned fields are backing the EIC initiative, this may give place to broader R&D and technology collaboration between Petronor and this business ecosystem; for instance, in relation to Petronor's projects in energy communities, power aggregation or microgrids, and particularly in sustainable mobility. In general, this can be a potentially fertile context for developing innovative solutions for end uses or final consumers, with synergies regarding SDG 7 and addressing value-chain or Scope 3 emissions (Greenhouse Gas Protocol, 2011; Ramaswami *et al.*, 2008; Huang *et al.*, 2009), which is a critical area in achieving an effective corporate strategy for net-zero emissions.

4.4. **Results and discussion**

Following the framework described in Section 3, in order to assess Petronor's sustainability strategy on the basis of the analysis carried out in the previous subsections and summarised in Tables 3 and 4, the different sustainability actions are clustered into groups of sustainability actions according to shared technological purpose (Table 5).

This way, each group may include several sustainability actions, as well as more than one specific technology within the ETP-CET Guide (for instance, «Electrolysis» in Table 5 refers to a number of electrolysis technologies in the Guide).

All identified Petronor sustainability actions are classified into 12 groups of sustainability actions (second column of Table 5) and these are ordered in terms of their relevance, as defined in Section 3.2.2 (i.e., using the TRL ranking first and then the «importance for net-zero emissions» score). Each group of sustainability actions is characterized by the TRL and «importance for net-zero emissions» score of the most advanced technology within the group (higher TRL, always according to the ETP-CET Guide criteria).

To facilitate the interpretation of the results obtained, these 12 groups of sustainability actions are further reclassified into four macro-groups that describe major lines of activity or value chains (fifth column in Table 5).

The first one (the «Cutting Edge» group) includes the first four areas of contribution, characterized by technologies with the highest TRL (9). Electrolysis and electric mobility are expected to have very high presence in the net-zero emissions scenario in 2070. Hydrogen supply for transportation and biogas production by pyrolysis treatment, on the other hand, are expected to have moderate importance in that scenario. This macro group represents activities in which Petronor has the largest potential for contributing to sustainability in the nearest future, as shown by the high TRLs.

Table 5. **MAIN CONTRIBUTIONS TO SUSTAINABILITY BY PETRONOR**

Relevance order	Groups of sustainability actions, TRLs and «importance for net-zero emissions»	SDGs	Sustainability actions (in Table 1 and 2)	Macro-groups
1-2	Electrolysis (TRL 9; VH)	7; 13	B7.3	Cutting Edge
1-2	Electric mobility (TRL 9; VH)	7; 13	A7.2; A0.1; B7.5; B7.6	
3-4	Hydrogen supply for transportation (TRL 9; M)	7; 13	B7.3	
3-4	Biogas production by pyrolysis treatment (TRL 9; M)	7; 13	B7.4	
5	Energy communities (TRL 8; H)	7; 13	B7.1	Electricity Value Chain
6-7	Power aggregation (TRL 7; H)	7; 13	A0.1; A0.2	
6-7	Microgrids (TRL 7; H)	7; 13	A0.1; A0.4	
8	Collaboration with natural gas DSO (TRL 6-7; M)	7	B7.2	Alternative Fuels for Transportation
9	Synthetic fuels production (TRL 5-7; VH)	7; 13	B7.3	
10	Refinery's CO_2 emissions reduction (TRL 5; M)	7; 13	A7.1/A13.3	Advanced Refinery Processes
11	Refinery's internal waste reduction (TRL 3-5; M)	13	A13.5	
12	Refinery's hydrogen production optimization (TRL 3-4; M)	7; 13	A7.3/A13.7	

Source: own elaboration. Note: The TRL is indicated in brackets for each field of contribution, as well as the «importance for net-zero emissions» score: very high (VH), high (H) and moderate (M).

A second macro-group («Electricity Value Chain») refers to areas of contribution to sustainability that include Petronor's innovative activities in the electricity value chain. Energy communities (TRL 8) and power aggregation with microgrids (both TRL 7) reach a high importance for net-zero emissions. This macro-group can be strongly linked to the electric mobility and electrolysis groups of actions in the Cutting Edge macro-group.

A third macro-group (labelled as «Alternative Fuels for Transportation») includes groups of sustainability actions that share a focus on alternative transportation fuels. One of these consists of Petronor's collaboration with the natural gas DSO (higher TRL within this group but moderate importance for net-zero emission) and the other refers to synthetic fuels production (lower TRL but very high importance). Both are based on assets or resources related to Petronor's traditional business, such as adapting existing petrol stations for natural gas supply or capturing CO_2 from the refinery operations to feed the synthetic fuels production. At the same time, they pave the way for innovation activities related to greener fuels.

The list of macro-groups is completed with one including three groups of sustainability actions that pursue improvements of the refinery's internal processes: CO_2 reduction, waste reduction and hydrogen optimization. This is the «Advanced Refinery Processes» group.

Generally, it can be observed in the sample of activities included in Table 5 that the lower the TRL is for a given technology (i.e., the further from the commercialisation phase it is), the lower the importance for net zero emissions is as well. This is due to the fact that the SDS is based on technology-adoption paths that account for the degree of matureness of the various technologies.

However, three fields of contribution do not abide by this logic: (a) hydrogen supply for transportation, (b) biogas production by pyrolysis treatment (which have moderate importance but are in high positions in the list) and (c) synthetic fuels production (which has a very high importance but is in a middle-low position). This leads to the following implications:

- The moderate importance of hydrogen supply for transportation means that hydrogen commercialization should probably focus first on feeding the production of synthetic fuels, and only later on supplying end-uses in areas that span beyond road mobility.
- The use of pyrolysis treatments to produce biogas is a relevant tool for the implementation of circular economy processes, but the focus of this group of sustainability actions is on displacing natural gas consumption in the refinery's internal processes and not on end-use applications. This justifies its moderate importance for net-zero emissions, as this product is not intended to be commercialized.
- Synthetic fuels production has a very high importance score and therefore may have a large market share globally in the 2070 SDS. At the same time, it

is the first driver of hydrogen production by electrolysis. The low TRL of this technology should therefore be improved by intensive R&D effort.

The overall order of macro-groups and the former implications can be interpreted jointly as follows. On the one hand, the groups of sustainability actions in the Cutting Edge macro-group should be the focus of Petronor's business development in order to achieve the largest contribution to sustainability, according to the framework presented in this article.

On the other hand, these groups of actions at the vanguard of the company's contribution to sustainability should not be considered in isolation but actually backed by the rest of the identified macro-groups. Petronor's work on electric mobility and electrolysis (and therefore, on hydrogen supply) can hardly be understood without the company's goal to develop activities in the electric sector (Electricity Value Chain macro-group). Additionally, this is more broadly linked to Repsol's work on these groups of sustainability actions through its subsidiary energy retailer Repsol Electricidad y Gas and by the group's EV charging technology company Ibil.

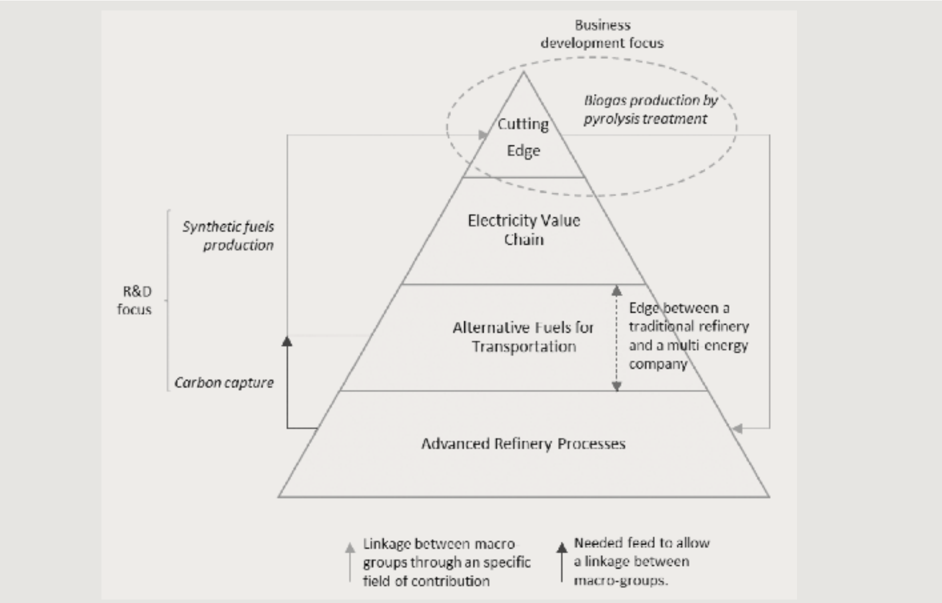
Also, the implications described above indicate that the Cutting Edge macro-group could be completed by one group of sustainability actions in the Alternative Fuels for Transportation macro-group; i.e., synthetic fuels production. At the same time, this activity is closely linked to the carbon capture process in the Advanced Refinery Processes macro-group. Both of them have relatively low TRLs, which suggests that the R&D effort of the company should pay special attention to these technologies in order to increase their matureness in as short time as possible in order to reap the benefits derived from the synergies between all these activities.

Finally, the Cutting Edge macro-group is directly linked to the Advanced Refinery Processes macro-group by the biogas production from pyrolysis treatment technology. This reduces the use of fossil fuels in refining, and together with the other fields of contribution related to the refinery processes, constitute critical actions in order to improve energy efficiency and competitiveness of the company's conventional business. This may help to support Petronor's bet over the long term on R&D and business models involving technologies in the Cutting Edge and Electricity Value Chain macro-groups, thus unlocking greater potential to contribute to sustainability.

This interpretation suggests that Petronor's contribution to sustainability through the Cutting Edge macro-group is somehow the «tip of the iceberg» of the company's actual contribution to sustainability (Figura 2).

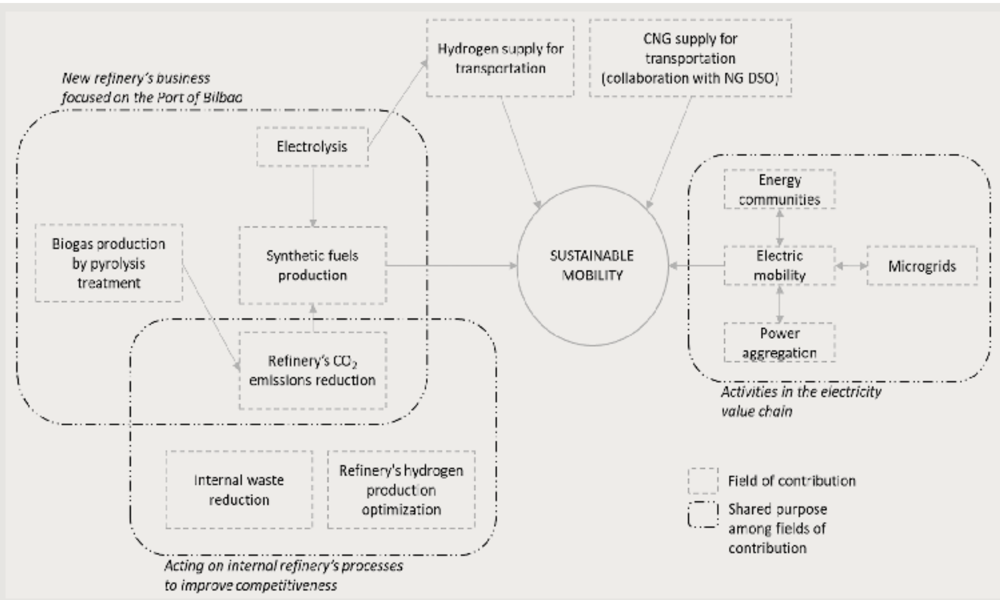
This shows a transversal relationship between the various macro-groups of sustainability actions that drives the process of developing a multi-energy company such as Petronor (and Repsol). This transition, heavily dependent on the development and adoption of new technologies, needs to be supported on a solid base of industrial capacities. Such relationship ultimately drives the bet on the activities in the Cutting Edge macro-group (hydrogen production from electrolysis and supply to

Figure 2. **AN ICEBERG CONCEPTION OF PETRONOR'S MACRO-GROUPS OF CONTRIBUTION TO SUSTAINABILITY**



Source: own elaboration.

Figure 3. **AN INTEGRATED VIEW OF PETRONOR'S CONTRIBUTION TO SDGS AROUND SUSTAINABLE MOBILITY**



Source: own elaboration.

transportation, electric mobility and, once its TRL is increased, synthetic fuels production). Although the precedent discussion argues that hydrogen production should not only be focused on (sustainable) mobility, the ambition to develop the latter is shared among these activities. This suggests that sustainable mobility could act as a common pivotal point around which Petronor's innovation activity and contribution to SDGs may spin, as shown in Figure 3.

Lastly, there are several identified sustainability actions for which a related technology in the ETP-CET Guide could not be found. However, their concordance with the areas of contribution to sustainability defined by UNDP *et al.* (2017) strongly suggest that they help to contribute to SDGs 7 and 13 as well. These can be seen as complementary actions to those in Table 5 and sustainability synergies between them may be exploited. For example, the application of ISO standards or participating in international associations and projects could lead to improvements inducing better operating performance and competitiveness of the Petronor refinery, while other actions like reforestation programmes may be aligned with nature-based solutions within the company's carbon capture objectives.

5. CONCLUSIONS AND FURTHER RESEARCH

The identification by an O&G company of those SDGs that are most relevant to its business, and how it is linked to them, is a useful first step in building a sound sustainability strategy. This is a necessary, but not sufficient, condition for the development of good sustainability policies at the firm level.

Such identification has to be carried out through the application of conceptual frameworks that allow a company to verify whether its self-analysis is correctly justified. This includes checking that no activity or action that can contribute to achieving the SDGs is left aside. But also understanding that different activities and technologies contribute to sustainability in different ways and that they should be prioritised, given that a company's resources are limited. This is relevant not only for the individual O&G company's business and its adaptation to a low-carbon economy, but also for the surrounding business ecosystem and the governments, in order to establish optimal sustainability and innovation policies both at the firm and at an economy-wide level.

In this article, a novel analytical framework is presented that facilitates the assessment of an O&G company's sustainability actions by using the SDGs as a benchmark. The proposed tool uses information provided by international organizations (essentially UNDP and the IEA) to characterize the sustainability strategy of a company as a series of sustainability actions linked to specific technologies. This way, a company's focus on the different SDGs can be evaluated and assessed in terms of the maturity of the employed technologies.

When studying the particular case of Petronor by applying the proposed framework, it is found that the company is well positioned to make relevant technological contributions to SDGs 7 and 13, but that this potential is underestimated in its Sustainability Plans.

The analysis conducted on the basis of the new tool helps to identify the most relevant areas of contribution to SDGs 7 and 13 by Petronor and organize them hierarchically. The vanguard of the company's contribution to these SDGs focuses on its current work on cutting-edge, innovative fields such as electric mobility, hydrogen production and pyrolysis treatment for supplying biogas to Petronor's refinery's internal processes. Increased R&D activity would be needed to include in this group the production of synthetic fuels.

An integral view of Petronor's sustainability efforts can also be generated by using this tool. The conclusion of the analysis is that these «cutting-edge» contributions to SDGs 7 and 13 by Petronor cannot be understood by just looking at the corresponding specific sustainability actions as an isolated group.

Indeed, Petronor's «cutting-edge» sustainability activities may be seen as the tip of an iceberg of a much larger, wide-scope strategy to develop a multi-energy, sustainable company based on a solid industrial base. The pivotal point driving innovation and contribution to SDGs in this strategy is sustainable mobility. The analysis in this article also highlights that the capacity to build a multi-energy company that contributes to SDGs 7 and 13 relies on a multi-stakeholder business ecosystem in which synergies and innovation spillovers can lead to a much broader contribution to the SDGs and to greater firm competitiveness.

This all suggests that the existence of an O&G company carrying out high-impact sustainability activities in a particular geographical area can act as a catalyst for effective decarbonisation policies, rather than an obstacle. But this leading role can only be played through an extensive bet on innovation and diversification of activities in a multi-energy context, with focus on multiple value chains. Otherwise, the diversification efforts may result in insufficient ambition and the company's sustainability efforts may be at risk of being seen as part of a greenwashing strategy.

While the analysis in this article includes some quantitative indicators (i.e., sustainability actions are ranked according to the associated technologies' TRLs and their importance to net-zero emissions scenarios, according to the IEA's ETP-CET Guide), it offers no insights on how energy companies contribute to sustainability in terms of measurable variables such as avoided CO_2 emissions by technology, investment levels in specific technologies and other socioeconomic factors. This issue and the strong limitation of the number of SDGs covered by this analysis constitute the main weaknesses of the proposed analytical framework.

Further research along these lines may help to better understand and value the impact of a company's sustainability policies and how beneficial investments in new technologies may be from a company's point of view and from the point of view of global sustainability. The framework described in this article may also be applied to compare sustainability strategies across O&G companies and to assess the evolution of a company's sustainability strategy and efforts over time.

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