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Consumer's skepticism: how personal characteristics influence the acceptance of the energy transition

Supervisor

Prof. Michele Costola

Graduand

Alice Sigura

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1. Introduction

The world is constantly changing and rapidly evolving; the increase in the population, the introduction of new technologies, the discovery of new materials and the innovation of old systems of production, are only few examples to highlight how societies are quickly developing. Aside from the many benefits these innovations are bringing, however, numerous are as well the negative aspects of this growth. Environmental problems and disruptive unexpected events are on the agenda and are becoming more and more dangerous and frequent.

The current economic models, moreover, are not able to explain and predict situations anymore, as they were developed in contexts of prosperity and wealth, and this is no longer the case. Resources are starting to diminish and the need to find some alternative sources is increasing day by day. In the specific case of energy provision, fossil fuels are becoming unsustainable and not the best way to address people's increasing needs. What is clearly needed is a shift towards a more sustainable economy, based on renewable sources, low emissions, and circularity. This shift is defined as energy transition and requires the movement towards renewable sources for the provision of energy, such as solar, geothermal, or hydroelectric sources.

The energy transition requires a big effort from the companies in the sector, as they have to completely change their business strategies and their systems of production. Many are the challenges there are facing, and the results are still very uncertain and unclear. A particular example is the Oil and Gas industry, not only because it is one of the main sectors in the energy provision, and thus one of the most impacted by the transformation. It is considered as well because it seems to be viewed as one of the least sustainable industries in today's society and the opinions on a possible switch to renewable sources are very controversial.

What becomes clear is the fact that companies can and must participate in one side of the energy transition, respecting new requirements and providing meaningful and complete documentation of the process. Apart from their efforts, however, change is required as well from consumers. Consumers are shaping all the industries by demanding specific goods and services, and they should as well start to ask for more sustainable solutions. This, though, requires people to modify their lifestyle, behave in more sustainable ways and introduce in their lives new environmental – friendly

technologies and products. It will be seen that this is easier said than done. Change is always a risk, and the introduction of new unknown technologies, to support a process with an unclear result, creates many psychological barriers in people and triggers the development of many skeptical thoughts on the process.

To see if there is a pattern in these doubts and uncertainties, a survey proposed to consumers of energy products will be presented and analysed. Some personal characteristics of a person may, in fact, influence the beliefs on the transition. This analysis should be helpful to understand where to put more emphasis and what problems should be addressed directly in order to demolish more easily some of these barriers.

In the first chapter of this project there is a general explanation of what is intended as sustainability, circularity, and sustainable consumption. As well, there is a brief overview of the current situation in Europe and in the world in terms of requirements, rules and sustainable programs introduced.

The second chapter contains a deep explanation of what the energy transition is and what it requires, both from societies and from the businesses. The section focuses on the Oil and Gas sector, defining how it is structured, how it works and what could be some problems and solutions for the entities in the context of energy transition.

The following part focuses on the consumer side of the energy industry. The chapter highlights their importance and the fact that it should very much start from them the requirement for a change. There is a quick overview on how people are currently behaving and how they should behave in the energy consumption context. Moreover, a specific analysis of what seem to be the main psychological barriers blocking a full engagement in the transition and how these can be addressed by entities and policymakers is provided.

In the last chapter it is presented the analysis of the data collected through a questionnaire. As a matter of fact, a survey has been proposed to consumers to better understand and study what are the biggest doubts related to the energy transition. The aim of the project is to understand the pattern and the main influential factors, if any, behind particular thoughts. This section starts with some general explanations on how the survey was collected and structured. Then, the sample coverage and distribution is analysed and the meaningful discoveries are reported. Finally, the answers are analysed through a particular mathematical model, namely the ordered logistic regressions. This

model allows seeing the effect of different independent variables, such as age, gender or educational level, on a particular dependent one. At the end, comments and conclusions on the results are presented and final considerations are highlighted.

The energy transition is an important topic in the current period and people are at the core of it. The scope of this project is, then, to understand the factors that play an important role in people's thoughts and decisions to better address them and to help remove, step by step, the barriers that are now present.

2. Sustainability and the current framework

In recent years, climate change, environmental degradation and resource depletion have become, among many others, growing and serious problems in our society. Governmental institutions and other collectives have mobilised to protect the environment and to create a more ecological world. At the same time, companies have started shifting their practices towards more sustainable systems of production, and consumers as well are demanding more and more environmental – friendly products and services. If, in the past centuries, the economies were developing in a situation of prosperity and abundance, it must be now taken into account the possibility of not having so many resources left to keep going in the same direction. Our developed world is highly dependent on fossil fuels and other non – renewable sources, but it is clearly needed a shift towards a more sustainable economy, lead by a transition towards low carbon emission practices and circularity.

The concepts of sustainability, circular economy, and sustainable consumption are being used constantly in our everyday lives and are generally understood by everyone.

As this chapter will explain, however, there is still a lack of proper definitions and frameworks on how to proceed and behave. Companies, consumers and all other parties are developing a feeling of distrust towards new ideas and technologies, due to absence of clarity and growing general uncertainty. Other than this, lack of awareness is as well part of the reason why these new concepts are still in the starting phase of their progress.

Nonetheless, in the last decades, sustainable practices have been developing and rising more and more and the whole economic world is shifting towards an increase in circular economic practices, as opposed to the usual linear ones. Among different sets of guidance provided by external organisations, the most important come from the Paris Agreement of 2015 and the UN Agenda for Sustainable Development. These frameworks aim to provide rules and suggestions on how to proceed, as well as to explain in a clear way what the current environmental, social and governance issues may be. There are some goals to be achieved in the next few years and explanations on the ways forward.

In this chapter there will be a theoretical overview with definitions and explanations of the main concepts used throughout the whole document, and a brief summary of the current situation in Europe and in the world in general.

2.1. Sustainability: overview, definition and current situation

The economic models mostly used in today's society are not considering possible environmental problems, as they have been adopted in periods of prosperity, where resources were abundant and issues related to carbon emissions were not yet in the picture (*Schoenmaker and Schramade, 2018*). Clearly, this is no longer the case and a shift towards more sustainable and environmental – friendly practices is needed and required. It is in this context that the concept of sustainability has been developed and taken into consideration.

Sustainability is a constantly – evolving notion: in the past few decades the thoughts about this topic have been varying and changing rapidly. As such, it is rather difficult to give a proper definition or a common meaning that is true and clear for everyone. Moreover, the concept seems to be so general, that it is being used in a number of different contexts, all with different meanings and uses, and sometimes almost contradictory between them.

According to *Salas-Zapata and Ortiz-Muñoz (2019)*, the proper definition should be analysed in relation to the use and the field of research, and can pertain to one of the following four categories.

1. Sustainability as a set of guiding criteria for human action

In this context, sustainability is related to human behaviour and, in specific, to the integration and the application of particular social – environmental criteria or qualities in people's actions.

2. Sustainability as a goal of humankind

Sustainability may also refer to an aim of society and its relationship with nature: people behave in certain ways to reach particular goals, these being environmental, social and economic.

3. Sustainability as an object

Sustainability here is viewed as an entity that can be studied or represented and can indicate a particular behaviour of some systems.

4. Sustainability as an approach of study

Finally, sustainability can also refer to the practice of studying social, economic and environmental variables within a particular system.

One of the most used definitions in literature, however, is still the one announced by the *World Commission on Environment and Development (WCED)* in 1987, in the *Brundtland Report "Our common future"*. According to this, sustainability means "using resources to meet the needs of the present without compromising the ability of future generations to meet their own needs". This implies seeking a way to ensure that the resources available today are not used to deprive the economic, environmental and social benefits of future generations (*Vivas et al., 2019*).

Nowadays, many international and national companies have integrated sustainability programs and set targets to meet, in line with the Paris Agreement framework and the UN Sustainable Development Goals (SDGs). This, nevertheless, is not as easy as it may seem. Companies need to integrate from scratch techniques that take into account social and environmental decisions, contrary to the usual cost – minimization for profit – maximisation frameworks, and the process requires time and effort.

In addition to this, there is an increase in the requirements for transparency and clarity on these topics coming from the Environmental, Social and Governance (ESG) rating agencies, as well as from investors, governments and consumers in general. All these policies and requirements have the final purpose of providing guidance and making companies compliant with regulations, while operating in a more sustainable way (*Silvestre, 2015*), but may put companies and consumers in critical situations.

There still is a long way to go to fully integrate sustainability issues in people's everyday lives, but this only implies more room for improvement and development.

2.2. Environmental, Social and Governance issues

In general, sustainability topics are studied in accordance with three macro topics: environmental issues, social issues and governance issues (ESG).

Environmental issues include all topics related to a company's behaviour in relation to natural resources, such as water and soil usage, climate strategy, or greenhouse gas emissions.

Social issues are connected to human activity, meaning the management of a company's relationships with consumers, employees and suppliers, as for example safety and culture development in the workplace, relationships with stakeholders or trust within people.

Finally, *governance issues* are those considered in relation to the management of an entity. Examples can be regulations to be followed, hierarchies and structures of the company, or other general corporate topics.

Economic, environmental and social are the three main dimensions, also recognized as “pillars” of sustainable development (*Nilashi et al., 2019*).

In general, ESG factors are being included more and more in the basic strategies of the companies. A lot of different types of data are available and ESG ratings and indexes are now being analysed by all the parties involved in the economic context. By companies, to track their processes and communicate them to external parties; by investors and external agents, to make decisions about the companies they are dealing with; by governments, to check the companies’ compliance with the requirements and to provide a common framework; and by consumers, to be as informed as possible about the products and services they are buying and the companies they are supporting.

The first set of indicators comes from the *Driving-Force State-Response* framework published in 1996 by the United Nations. These indicators show the current state and evolution of the environment, as well as the major concerns to help policy – makers make important decisions on the basis of the information provided (*Lafuente-Lechuga et al., 2021*).

ESG integration is increasing and becoming a core practice for most of the companies, but it has some downsides as well. Among others, one problem is related to the diversity of the data available, which makes it very difficult to understand it and most of all to compare different companies, especially if different in size, procedures, or objectives. A second critique is related to the fact that some issues may not be related to either one of the three dimensions and should be captured in other ways.

As stated, it is obvious that ESG frameworks and practices still have a long way to go, but the initial integration and awareness is already a big step towards the future.

2.3. Circular economy: principles, definition and challenges

In relation to sustainability topics, an important role is played by the concept of circular economy.

A circular economy, contrary to the linear economy, is a business model in which no resource goes wasted and the products are kept in the cycle as long as possible. What is

unusable for a particular goal can be repaired and adjusted to be functional somewhere else along the chain, making longer the usability phase and delaying the discarding moment. This model implies a radical transformation of production and consumption systems (Camacho-Otero et al., 2018).

One of the most recognized definitions of circular economy comes from *Ellen MacArthur Foundation* and is represented by the “butterfly diagram” that can be seen in Figure 1. According to this, the circularity is represented by two different cycles that illustrate the continuous flow of materials: on one side the *biological cycle*, where the nutrients from biodegradable materials return to the Earth to regenerate nature; on the other side, the *technical cycle*, where products and materials are kept in circulation through processes such as reuse, repair, remanufacture, and recycling. Both are influencing and influenced by many actors and activities and the consumer is placed in the centre.

The definition coming from this concept includes the three circular economy principles: (1) preservation and enhancement of natural capital; (2) longer circulation of products and materials in both circles; (3) designing out waste¹.

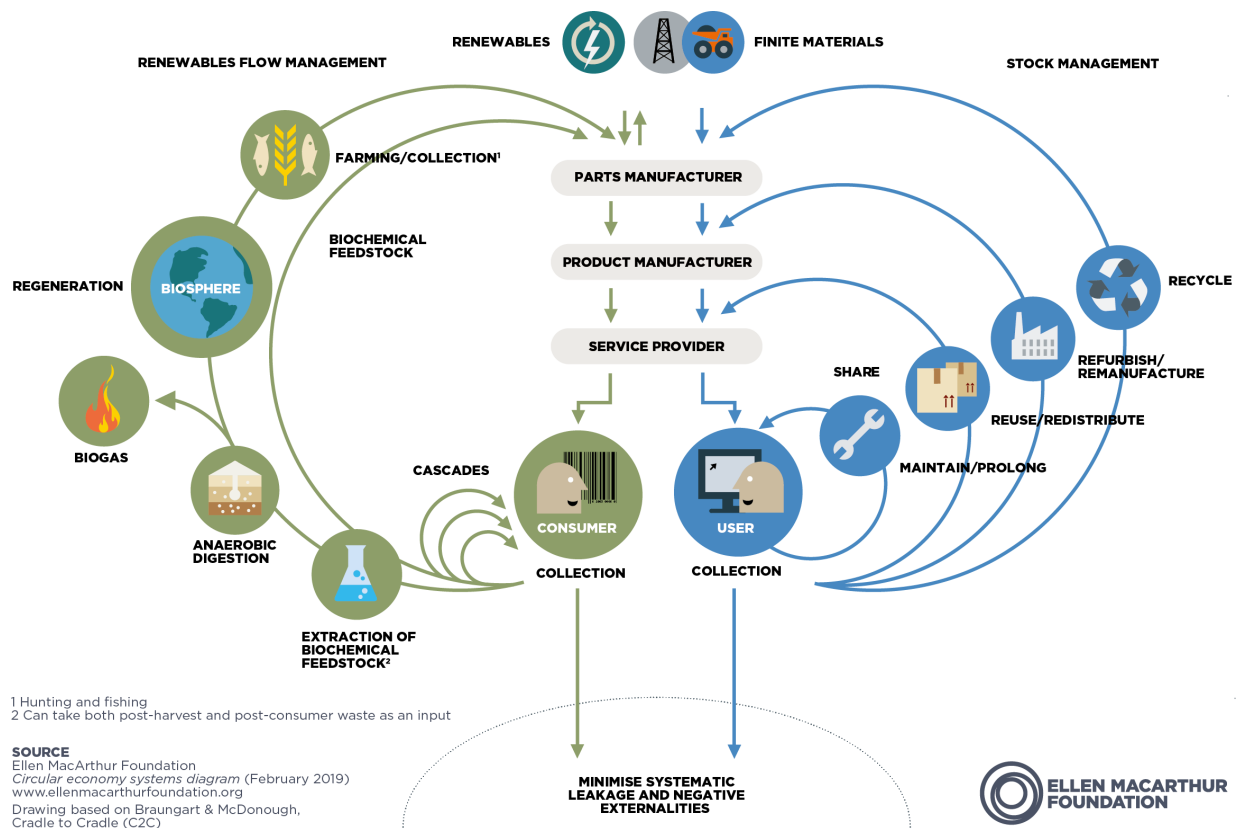


Figure 1: The Butterfly Diagram of Circular Economy - Source: Ellen MacArthur Foundation, <https://ellenmacarthurfoundation.org>

¹ Ellen MacArthur Foundation: <https://ellenmacarthurfoundation.org>

Products will follow three steps in the circular business model:

1. *Pre – usage phase*

Here the product is manufactured, extracted and distributed. The goal is to make it as performing as possible, so that it can be kept in use for a longer period.

2. *Usage phase*

The second part is where the product is optimised; the aim is to provide consumers and other parties with additional services and/or components, so that duration and performance are extended. During use, the maximum value of the products should be extracted.

3. *Post – usage phase*

In the final phase, the purpose is to replace the idea of “end-of-life” of a product with concepts of alternatively reusing, recycling, and recovering. In other words, to find a way to recuperate and regenerate the product to a new initial condition, making it reusable and able to start another life cycle.

One of the biggest problems with this new model seems to be the fact that there is no international policy effort yet to integrate circular economy approaches, and with it, it is missing as well accurate, traceable and secure data about the processes followed by entities and their results. The implication is the inability to make projections and future decisions, limiting the awareness of the benefits of the model (*Geng et al., 2019*).

Another weakness is similar to the one that is limiting the general development of sustainability ideas and concepts: circular economy seems to be a collection of vague and separate ideas coming from several fields and semi-scientific theories. The concept is still superficial and unorganised (*Korhonen et al., 2018*).

2.4. Sustainable consumption and sustainable consumers

In every type of economy, consumers and their behaviour play an important role. Customers are a fundamental part of every economic practice as they can drive suppliers to make changes and provide different types of products and services according to their needs and expectations. In this regard, the concept of consumption in the context of circular economy can be addressed as sustainable consumption.

According to *Tunn et al. (2019)*, sustainable consumption means shaping and satisfying consumers' needs while reducing negative impacts caused during material extraction, production and consumption.

Following *Camacho-Otero et al. (2018)* study, in a sustainable consumption framework it is possible to find four groups of consumers.

The first group is represented by consumers that make rational choices, meaning they take decisions based on a "costs versus benefits" approach. This group would choose, based only on self-interest, the option that maximises utility or minimises costs.

The second group contains all consumers that still make decisions based on a specific goal, expected outcome or reward, but with a more planned behaviour. Here more specific factors will influence the final choice, such as attitudes, values, or beliefs.

In the third group, the consumers are expected to adopt a more cultural approach to understand consumption, analysing also their lifestyles and identities. What is considered here are "the dynamics of consumer actions, as well as the marketplace and cultural meanings". Consumers are concerned with the entire consumption cycle and provide insights on identity creation and differentiation.

Finally, the last group is made up of consumers that use a socio-material approach, focusing on practices rather than behaviours.

What is obvious from these studies is that the introduction and acceptance of the circular economy can be quite uneasy. Cultural barriers, as well as different other psychological factors, play a significant part in the tolerance of new products and technologies. The circular economy will bring significant changes in people's everyday lives, among many, for example, the need to give up the requirement for ownership and newness, and to engage in behaviours such as repairing and returning goods (*Camacho-Otero et al., 2018*). This requires a big effort and awareness from the consumers side, and will for sure influence the outcome and integration of new sustainable economic practices. Other than this, as well the lack of consumer awareness and interest, due to unclear and hard-to-find data, are factors influencing the transition towards circularity. As it is true for the ESG ratings, here as well the future integration of different economic models will require clearer and more defined rules and explanations that should be available for everyone.

2.5. ONU Agenda 2030 and the Paris Agreement

Due to a rapid increase in environmental issues involving the whole world, institutions and other collectives have started the mobilisation to provide clearer frameworks and guidelines to follow. The European Union, for example, moved towards a multilateral approach, supporting as a unit the UN and other institutions such as the World Trade Organization (WTO). The final goal is for the whole world, or at least the whole EU, to act together to ease the environmental problems. Considering this as one of the biggest motives pushing European countries to cooperate and coordinate, the final big step was reached in 2015 with the Paris Agreement on climate change (COP21).

The Agreement, a legally binding international treaty, was adopted by 196 Parties to the UN Framework Convention on Climate Change (UNFCCC) in Paris, on the 12th of December 2015 and entered into force on the 4th of November 2016. It set some goals to be reached in the next years in order to limit the increase of global temperatures and emissions, assuring at the same time transparency and accountability. What made the Agreement easily acceptable and supported by all countries, contrary to the previous similar attempts, is the flexibility that it allows to countries, understanding that all have different needs and capabilities (*Delbeke et al., 2019*).

With guidance by the International Panel on Climate Change (IPCC), the biggest target is to limit the increase of the global average temperature to 2°C until reaching the final goal of 1.5°C, compared to pre – industrial levels. As a second objective, the Agreement's purpose is to shift from the current economy, mostly dependent on fossil fuels, to a new one with “net zero” global emissions.

Other than this, the United Nations has developed a plan, the 2030 Agenda for Sustainable Development, with guidance and rules to achieve a sustainable development. The Heads of State and Government and High Representatives met in New York from the 25th to the 27th of September 2015 to stipulate global Sustainable Development Goals (SDGs). The UN set 17 goals, in Figure 2, grouped in three big interconnected categories: economic goals, societal goals, and environmental goals. All together, they aim to end poverty, improve health and education, reduce inequality, tackle climate change and work to preserve the oceans and forests.

SUSTAINABLE DEVELOPMENT GOALS



Figure 2: The 17 SDGs - Source: United Nations | Department of Economic and Social Affairs, <https://sdgs.un.org/goals>

The idea behind this framework is to have a global strategy followed by all the countries, where defined rules, policies and taxation principles can guide the way forward. These goals are further expressed through 169 targets and should be achieved by 2030.

As officially stated, “We resolve, between now and 2030, to end poverty and hunger everywhere; to combat inequalities within and among countries; to build peaceful, just and inclusive societies; to protect human rights and promoter gender equality and the empowerment of women and girls; and to ensure the lasting protection of the planet and its natural resources. We resolve also to create conditions for sustainable, inclusive and sustained economic growth, shared prosperity and decent work for all, taking into account different levels of national development and capacities”².

² United Nations | Department of Economic and Social Affairs: <https://sdgs.un.org/2030agenda>

In conclusion, due to a rapid worsening in the environmental situation of the world, a shift towards more sustainable forms of production and consumption is required.

To this day, it still seems complicated to find a unique definition of what sustainability is and what sustainable practices entail. The same happens for other related topics such as circular economy and sustainable development.

However, thanks to the Paris Agreement and the UN Sustainable Development Goals, it is available a framework and a set of guidelines to follow, that already lead to an increase in the dedication of entities and consumers towards a greener development of the economy. As well, ESG ratings and similar types of data are being integrated and studied by companies, consumers and investors, and allow a certain degree of certainty when performing analysis and making decisions.

Even though it is still the beginning, it can already be seen the shift of most of the businesses towards circular practices of production, and of consumers towards a more sustainable form of consumption.

It is still uneasy to foresee what the outcome of this shift will be and how long it will take, and the unclear and undefined numerous frameworks that are present in this moment for sure do not help with the acceptance and the speed needed for the change.

What is clear, is that this is undoubtedly the right direction to go, as the resources are becoming more and more scarce, and a change in people's lives and entities' practices is fundamental.

3. The energy transition and the oil and gas industry

The increasing environmental problems in today's world have led people and collectives into thinking how more sustainable practices should be integrated in every aspect of their lives. One approach, adopted in the energy sector, is the energy transition. This concept requires companies and consumers to shift from fossil fuel – based systems of production and consumption, towards other renewable sources of energy, such as solar, geothermal, or hydroelectric.

The proper definition of energy transition, as it will be explained in this chapter, can slightly vary in relation to the different point of views and reasons behind the choice of shifting to new renewable sources. It can be company, social, environmental or political based. What is clear is that this practice requires a big effort both from the companies, which have to completely change their strategies and business models, and from the consumers, who have to adapt to new products, services and technologies. It will be a complex and long procedure whose results are still unclear and difficult to predict.

The focus of this chapter will be the energy transition in the oil and gas sector.

This particular industry was chosen for two main reasons. On one side, because it is one of the most impacted by the transformation, being one of the prevalent in the energy sector and one of the biggest energy providers. On the other hand, because it is being more and more at the centre of discussions due to its huge environmental impact and its importance in the current society.

This chapter will first provide a general explanation of what the energy transition is and what it requires.

It will then proceed focusing on the oil and gas industry, with a brief overview on how the sector is structured, the environmental impact it has, and the reasons behind its importance in today's energy provision.

Then, the energy transition will be taken into consideration again keeping the focus on this specific industry, with an analysis of what the oil and gas companies are already doing, what are the strategies and business models they can adopt to start the transformation, and what are the risks they are facing.

Finally, there will be a brief overview of the current status of the transition, as well as an explanation of the benefits it is bringing and will bring to society today.

3.1. Energy transition: general outline

In order to achieve the Paris climate goals and all the other requirements set in the last decades, many are the approaches adopted by companies, consumers and other collectives. In fact, governments of the majority of the countries have recognised the importance of the climate change concern, and in most of the cases the issue has been declared a real climate emergency. Dealing with this problem would mean, among other things, to replace fossil fuels energy sources with renewable alternatives (*Sauhats et al., 2021*).

As stated by the *International Energy Agency*, “the climate change is essentially an energy challenge”³, and that is the reason why hereafter the focus will be on one of the most important ways forward implemented by the energy sector: the so – called energy transition.

By transition is meant a shift away from fossil fuels towards more sustainable energy sources, still keeping the supply of energy as unchanged as possible not to alter the current lifestyle. Examples of other renewable energies that can be used are hydroelectric, geothermal, solar, or wind sources (*King and van den Bergh, 2022*). In other words, the transition is a long – run structural change in energy systems to adopt new sources of energy.

This framework includes a transformation of all the energy-intensive sectors of economic activity: power generation, supply and consumption, heat generation and supply, electrification of transport, agriculture and households (*Sauhats et al., 2021*).

The reason behind the need for an energy transition is clearly explained by *Schoenmaker and Schramade (2018)*, who state: “Our economic models were developed in the age of resources abundance, when natural resources were plenty and carbon emissions were limited. [...] Possibly fatal depletion of resources is ignored. These models are still widely used, but no longer tenable.”

Consequently, it is needed to shift towards a more sustainable economy, which should be based on renewable resources, low carbon emissions, and circular business models.

Summarising the literature around the topic, the energy transition can be seen from four different points of view. The transition, in fact, requires a decrease in the use of

³ International Energy Agency (IEA): <https://www.iea.org/topics/net-zero-emissions>

fossil fuels towards greener solutions, but the reasons behind this change can vary, and this implicates some slightly different definitions and approaches.

From one point of view, the energy transition is considered as a purely *company – strategic issue*: the entities in the energy sector are choosing to change from fossil fuels – based practices to other renewable energy sources, with the purpose of adapting to a changing environment and complying to a modification in consumer's and government's demand.

Secondly, the energy transition can be seen as a *social issue*. Consumers are changing their preferences and demanding greener products and services, and this is leading to a change in the form of energy consumption of the society.

A third view is *environmental – based*: climate change and all the current environmental problems are issues that must be taken seriously, and shifting towards new energy sources can ease the existing situation and avoid possible future complications.

Finally, for some authors, the energy transition is mainly a *political issue*. Companies are required to change their practices and do not have many other choices if they want to comply with the increasing regulations and policies coming from governments and other external parties.

No matter the reasons leading a company towards this shift, according to *Fattouh et al. (2019)*, this transition is complex and requires a change in three interrelated dimensions: the tangible elements of the energy systems (technologies, infrastructures, markets, production equipment, consumption); actors and their conduct (new strategies, different investment patterns); and socio – technical regimes (regulations and policies). This makes it a complex, non – linear and highly uncertain transition.

The expectation for the future of the transition is a development of a S-shaped curve, where: at the beginning new technologies and practices will enter the market slowly. They will then accelerate the integration in the second phase and finally diminish their impact again when becoming mature and stable in the market (*Fattouh et al., 2019*).

In the context of transitioning economies, the companies can behave in two different ways. On one side can be seen those that are actively taking place in the transformation, called future makers; on the other, those waiting for something to happen before making any decision, the future takers (*Schoenmaker and Schramade, 2018*).

What is clear is that future takers are not acceptable anymore, and every entity has to find a way to actively become a part of the solution.

3.2. Oil and Gas: industry overview

The oil and gas sector, as *Mojarad et al. (2018)* state, is one of the main sources of energy in the world and among those with the biggest impact on the growth of the global economy. Oil and gas industries supply more than 50% of global fuel consumption and are expected to remain in this position for at least the next 10 years.

This industry plays an enormous role in our everyday lives because of the fact that it includes three big vertically integrated sectors: indeed, the value chain is composed of upstream, midstream and downstream activities (*Doe et al., 2021*). The value chain, explained hereafter, can be graphically seen in Figure 3.

1. *Upstream activities*, also known as E&P, are mainly exploration and production. In this sector it is firstly searched for potential on-shore or off-shore crude oil and natural gas; then, exploration and appraisal wells are drilled.
2. *Midstream activities* include the distribution systems, such as tankers and pipelines to carry crude oil to the refineries where it is stored.
3. *Downstream activities* refer to refining crude oil, processing natural gas, marketing, or retail distribution.

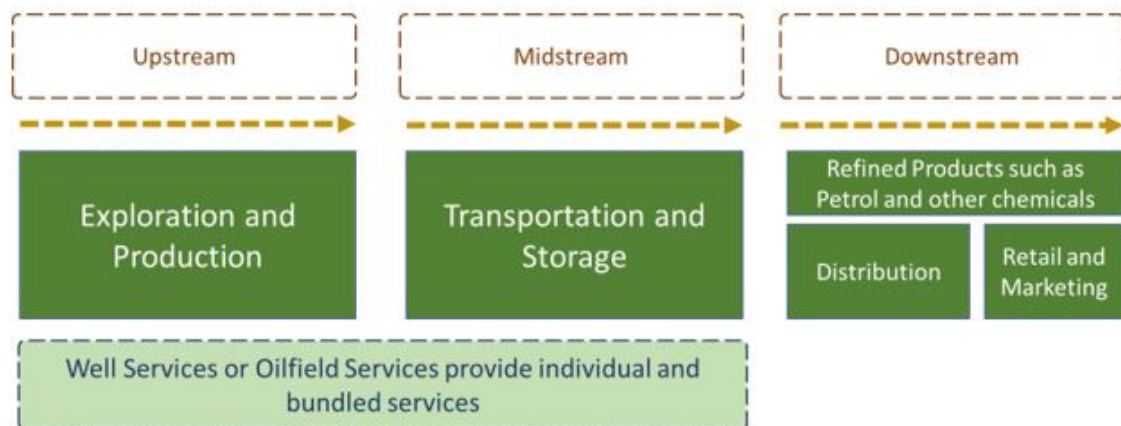


Figure 3: Oil and Gas Value Chain - Source: Hindustan Oil Exploration Company Ltd, <https://www.hoec.com/oil-and-gas-value-chain/>

What makes it very hard to give insights about the oil and gas industry is the fact that it is composed of many different mixes of corporate structures and governance models, that space from small enterprises to world large corporations. Obviously, risks and opportunities, procedures and regulations may vary a lot across this spectrum (*IEA, World Energy Outlook Report, 2020*).

Following the *International Energy Agency* structure, it is possible to distinguish four main groups of companies in this sector:

- *NOCs* – *National Oil Companies*, fully or majority-owned by national governments, that concentrate on domestic production. Examples are national Iranian Oil Company, Qatar Petroleum or Petrobras in Latin America.
- *INOCs* – *International NOCs*: again, companies fully or majority-owned by national governments, which have both domestic and international operations (mostly in upstream). Examples are Equinor or the China National Petroleum Corporation.
- *Majors*: privately owned companies, integrated and listed on US and European stock markets, mostly focused on large and capital-intensive projects. Examples are BP, Shell or Eni.
- *Independents*: privately owned companies, similar to the Majors but smaller in size or independent upstream operators. Examples are the Russian Lukoil, Repsol in Europe or Hess in North America.

As said, oil and gas are a fundamental part of the energy sector, such that it is believed they will have a long future. Among many reasons for this, what cannot be denied is an expected increase of the global population that will lead to a probable rising demand for the services that energy provides. Secondly, oil and natural gas still play critical roles in today's energy supply and economic systems (*IEA, World Energy Outlook Report, 2020*). Another important topic to mention in relation to the oil and gas industry is the relevance that it has on all aspects of a society. Apart from the above-mentioned environmental related pressures, as a matter of fact, the industry is highly influenced as well by social and political concerns. Due to the large scale of the operations, located in different areas of the world, the companies have every day to face different political situations, various cultures and comply with a number of diverse regulations. This can influence the acceptance to new projects and new infrastructures, as well as the ability of a company to acquire resources and start the processes in the supply chain.

It is for sure a broader topic out of the scope of this project, but just to mention an example, the recent conflict started between Russia and Ukraine, definitely had an important impact on this sector. Russia was one of the major oil exporters in the world, in Europe in particular, and the sudden markets' reaction to the Russian oil and gas

disruptions led to an important increase in energy prices. Without going too much into details, the example was just a proof to show how this industry is extremely complicated and affected by many different factors linked to every aspect of a society. The undeniable conclusion is that all the changes, such as this energy transition, must be analysed in detail, as they will have a huge impact on the sector and the whole world with it.

3.3. Environmental impact of the oil and gas sector

The relevance of the oil and gas sector is not just limited to its fundamental role in our societies and the energy provision. It is as well very much analysed also because it has a big environmental impact, and for this it has been more and more questioned in our sustainable society (*Ahmad et al., 2017*).

This industry, as a matter of fact, is based on highly specialised activities that take place in sensitive environments; the products created, transformed, and transported could lead to disastrous consequences for the environment and the people if not treated with care. As well, the activities of extracting the materials are delicate and must be done in certain specific ways.

As the *International Energy Agency* states in the report *The Oil and Gas Industry in Energy Transitions of 2020*, “as of today, 15% of global energy related GHG emissions come from the process of getting oil and gas out of the ground and to consumers”.

This and many other problems related to climate change or environmental degradation have been addressed to this industry and in general to oil and gas production. Major companies have been accused of creating disorders and environmental issues.

In recent times, thus, the pressures to change this situation from governments, investors and consumers, are increasing. The industry has seen an intensification in the requirements for transparency and for promoting sustainable practices along the whole chain, even though there is not yet a standardised approach among the companies on how to proceed. The increasing pressures on the companies in this sector are leading to doubts and uncertainties about the role of fuels in the change and the company's positions in the societies⁴. Consumers, for example, are actively re-thinking the use and need for fossil fuels in their everyday lives, trying to find substitutes and alternatives.

⁴ International Energy Agency (IEA): <https://www.iea.org>

The increasing concerns and willingness to change the general behaviour, though, do not exclude the fact that oil and gas will for sure still remain among the most important sources of energy for the next decades. Even so, the conclusion is not that the importance of this sector implies no need for change but rather the opposite.

As a clear consequence, precisely, in the past years, some of the biggest world leaders in the sector have started the transformation towards a low carbon economy, contributing to the social, environmental and economic well – being of communities (*Schaltegger and Wagner, 2017*), redefining their business development strategy on the basis of sustainable development. Nowadays, these are being followed by most of the entities in the field, no matter the size or the geographical relevance.

Finally, many organisations such as IPIECA, API and OGP are active in organising sustainable development management standards, encouraging oil and gas companies and their shareholders to provide reports, consolidating with and adhering to sustainable development strategies (*Mojarad et al., 2018*).

What is to be discussed, then, is not whether the oil and gas industry can or will change, but rather how they are proceeding to do so and what is or can be the response of consumers, governments and investors.

3.4. Energy transition in the oil and gas sector

As mentioned, the energy transition is impacting different energy sectors, but one of the most relevant in the process is for sure the above-described oil and gas industry.

Oil and gas companies are proceeding with the transition, but have to face the double challenge of adapting to the change in the requirements from consumers, investors and other external agents, as well as to find ways to actively contribute to the decarbonisation of the energy sector. Stated differently, companies are required to deliver energy services on one hand, but at the same time are asked to reduce emissions and change their daily procedures (*IEA, 2020*).

Nowadays, there are more and more policies for the oil and gas sector to disincentivize fossil fuels in favour of renewable energy solutions, among many: carbon pricing and the European Union's Emission Trading Scheme (*Geffen and Rothenberg, 2000*).

Oil and gas industries are thus inevitably rethinking their business models and their way of doing business. Their responses are the key determinants to how these are

viewed by consumers, governments and shareholders. Companies are asked more and more to clarify their operations and business models in the transition processes, as well as to clearly explain their contributions in the reduction of greenhouse gases. The companies have then to find solutions to stay in the market, while contributing to global climate change mitigation. Some of the approaches adopted by companies are, for example, implementing strategies such as increasing the share of gas and low – carbon oil in their portfolios, purchasing carbon offsets, or encouraging end – user energy conservation through efforts such as ridesharing (*Shojaeddini et al., 2019*). Entities try to reduce carbon emissions by: increasing energy efficiency in operations and products; investing in renewable energy, such as solar, wind, biomass, geothermal, hydro – power or marine energy; investing in low – carbon technologies, such as electric vehicles or hydrogen technologies; and implementing carbon capture and storage.

Apart from these specific examples, in general, a company can engage in the transition in many different ways. *Shojaeddini et al. (2019)* recognise four main approaches:

1. Integrating low – carbon technologies into oil and gas production;
2. Expanding beyond oil and gas production;
3. Not engaging in low – carbon investments or emissions reduction;
4. Aiming to lower operational emissions.

To explain these four bullet points, it can be stated that, if bringing down emissions is a fundamental step to reach environmental gains, it is also vital for companies to set up more investments in low carbon hydrogen, biomethane and advanced biofuels (*IEA, 2020*).

According to *Fattouh et al. (2019)*, one of the biggest challenges for the oil companies in the transition would be how to position themselves and how to be an active part of the renewables’ “revolution”. To explain this better, the companies in this sector need an adaptation strategy to adjust in the new situation. This implies a dilemma: better to wait and expect some more certainty, risking giving the competitors a competitive advantage, or to make big investment decisions, limiting in some way the future options and risking asset write-offs? They would need to gradually extend their business model and try to build an integrated portfolio including both hydrocarbon and low – carbon assets. It can be stated that, in the long run, the main challenge for the companies will be economic diversification. These authors believe that “the global energy transition will not only shape political and economic outcomes in oil – exporting countries, but the

transformations in these major oil – exporting countries will, in turn, shape the global energy transition – adding another layer of uncertainty to the already complex phenomenon”.

It is still soon to have a clear idea of what the future of the transition will look like. The process is long and the short – term results are not easy to see or collect. Some of the factors that may affect the outcome are for example the rapidity of technological innovation, the ambition of energy policies, the market dynamics or other societal trends (*IEA, 2020*). The *International Energy Agency* believes, however, that the current status of the transition is not developed enough to compete with the expanding global economy and the increase in global population.

3.5. Risks and barriers of the energy transition

Clearly, the transition will require time, effort, and most of all the development of new technologies. These requirements can create some psychological barriers coming both from consumers and the companies in the transition themselves.

What is needed is the acceptance of new inventions, by industries that have to implement them, by consumers who have to adapt to new offers in the markets, and by investors that have to support the entities not knowing precisely what the outcome could be. Adjusting to new procedures, new requirements and new models could potentially be a time consuming effort and delay the already long transformation. Even though the costs of developing low-carbon technologies may represent an investment in companies’ ability to prosper over the long term (*IEA, 2020*), the companies must be convinced, convincing and fully on-board.

Moreover, the rapid changes required and more and more introduced are leading to a situation of uncertainty in many other different dimensions.

One is for sure the availability of clear results that could be useful in convincing people about the efficiency of the transition.

Secondly, the speed of the process will vary from region to region; it is clearly happening fast in some regions, such as the EU, but definitely slower in many others with less possibilities and capabilities. The difficulty is that, no matter the speed of the transition, it seems tough to have short – term tangible results.

A third issue could be the unpredictable final result, as it seems quite challenging to forecast now which may be the winning technologies and what energy mix will prevail (*Fattouh et al., 2019*). Uncertainty about the future is a key challenge facing the industry during this transition.

Linked to that, there seems to be as well a feeling of distrust towards the general concept of energy transition. There are perspectives believing that the world does not have sufficient “carbon budget” or time to keep the transition going (*Robert et al., 2020*). What is also problematic, given the variety of the players in this industry, is that there is no single strategic response for all.

Finally, it is possible that the energy transition will result in higher costs of energy, mostly in the short and medium term, as there will be the need to cover the starting costs of installing new infrastructures and technologies (*Carley and Konisky, 2020*).

From the company’s perspective, an additional threat is the possibility of a loss of financial profitability following the need to adapt new unknown strategies and offering different products and services.

In general terms, apart from the acceptance of the transition, according to *Fattouh (2019)*, four biggest types of risk can be identified during the transition:

1. *Demand and technology risks*

These risks include the inevitable change in volume of goods and services exchanged as well as the technologies used to produce them. Starting processes with new technologies holds high risks if these prove not be effective in the long – run.

2. *Market price risks*

There are multiple factors that impact the way in which non – policy related prices of goods and services are set.

3. *Policy risks*

Following and trying to comply with external regulations, performance and production standards, and all types of policies, will have an impact on the transition. From an historical point of view, many policies were created to support oil and gas production. With the transition, however, these policies will rather create disincentives, such as implementing carbon taxes aimed at reducing GHG emissions (*Robert et al., 2020*).

4. *Other risks*

All other risks that may affect the companies and their strategies and that are not included in the three categories above.

The conclusion that can be drawn from this is that the energy transition will have a huge impact on the oil and gas sector and society. Companies will have to study and analyse with precision their ways forward, as many are the possible risks they could be facing. Consumers, on the other hand, are required to conform and adapt to new sources of energy and technologies, still quite unknown and with unsure effectiveness. This, however, should not discourage companies and consumers in believing the energy transition is the right way to go, as the need to have it in place are stronger than the barriers to face, and the benefits it will bring and is already bringing are undeniable.

3.6. Benefits of the transition

It is clear by now that the energy transition is developing in these last years and it is just at the beginning of the evolution. Undoubtedly, many are the changes that still need to be implemented and many more regulations and clear explanations on how to proceed are expected.

Nonetheless, it should not be avoided to comment on the many developments happening in the recent decades and the benefits that this transition will bring and is already bringing in today's world. Worth mentioning again are the obvious positive effects, already stated many times.

One is clearly the protection of the environment, coming from an increase in the use of cleaner sources of energy and a reduction in the emissions following the decrease in fossil fuels' usage.

Secondly, development of new technologies and of the energy sector in general, will be a strong positive driver of change and expansion of the whole industry.

Moreover, *Ram et al. (2019)* recognize that transitioning to a low carbon economy is resulting in additional jobs being created and existing jobs being substituted and transformed. Examples are the increase in jobs in manufacturing, construction and installation, operations and maintenance, sales and distribution, fuel extraction and supply and transmission. Just to mention some numbers, as of 2017, renewable energy industries employed about 10.3 million people across the world (*Carley and Konisky, 2020*). The International Renewable Energy Agency (IRENA) has estimated jobs associated with renewable energy to rise around 16.7 million by 2030⁵.

⁵ IRENA | International Renewable Energy Agency: <https://www.irena.org>

The ones mentioned above are just some of the many benefits the energy transition will bring in today's lives. The important concept to be understood is that, no matter the downsides of the transformation or the amount of improvement still needed in this field, the economic, social and environmental upsides it can and will bring are definitely worth the effort.

To sum up, the energy transition is a concept that has been developing in recent times. As such, explanations and frameworks on what should be the best way to approach it are still missing. Moreover, the energy sector is vast and it includes a number of different industries and different situations, which implies the impossibility to have a common framework valid for everyone.

The oil and gas sector is one of the most impacted by this need for change and one of the most criticised when mentioning sustainability concepts. With its vertically developed supply chain and its important environmental impact, it is a fundamental character in the energy sector and in our society in general.

In the energy transition context, the oil and gas companies will have to completely reshape their strategies and business models, as they will have the double objective of complying with new requirements and regulations while staying in business and keeping providing energy. Different are the ways forward they can adopt, and these will bring with them a number of risks and barriers.

Nevertheless, aside from all the efforts required and the barriers already present, many are the benefits an energy transition could bring. Environmental protection is for sure one of the most important, but other than this what can be mentioned are the economic development of the sector, as well as the technological development of new instruments and practices, and job creation.

After the analysis of some of the possibilities and risks involved in the transition, what remains clear is that there is still a lot of room for improvement, but for sure the future is requiring this transition to happen in the best and fastest way possible.

4. The role of consumers in the energy transition

The initialization of an energy transition is an important topic in today's world and is clearly affecting all parts of the energy market. On one side, companies are at the core of this transformation as they are required to change and modify their practices, strategies, and the type of products or services they offer. On the other side, consumers are fundamental in this context because they as well need to shift their preferences towards new forms of energy and adapt to new technologies, also changing their behaviour into a more sustainable one.

It is clear by now that this big transformation will take time and effort, as changing the usual form of production and consumption can lead to uncertainties or fears about the results and doubts related to the efficiency of the new instruments proposed. As it will be explained, psychological barriers are numerous and are affecting the speed and outcome of the transition.

The following analysis will be focused on the consumer side of the energy market, because it is evident that one of the biggest motives pushing companies' decisions and strategies is what consumers demand and request. As well, it cannot be denied that consumers' behaviour has a huge influence on the environment, and pre- or post-consumption decisions can have an effect on the result and its impact on future generations.

In this chapter there will be first a brief market overview of the energy sector to highlight that, even though the focus will be on the consumers, many are the factors influencing this industry.

Following, there will be an analysis of people's behaviour in this specific sector and an explanation of the importance of including their preferences when making decisions.

The subsequent two sections will put emphasis on how the consumers can behave in this context and which can be considered acts of sustainable consumption.

There will then be an overview on some psychological barriers or common worries and an explanation on how these can be addressed by external agents, such as policy makers.

Finally, it will be mentioned how the energy sector is vast and impacts different types of people in distinctive ways, creating some injustices and unfairness. The aim of this section is to make it clear that there cannot be one unique solution valid for everyone.

All the explanations and the topics analysed in the context of energy consumers are part of a general overview of the sector, but the important conclusion is that every situation has to be carefully analysed in the context and the framework around it.

4.1. Summary of the energy market

It is clear by now that the oil and gas industry operates in difficult and sensitive environments, and it is characterised by an important interconnection of environmental, socio – economic, political and regulatory settings (*Ahmad et al., 2017*).

For a quick overview of all the forces that are impacting this sector, *Ahmad et al. (2017)* propose the following PESTEL model, i.e., political, economic, social, technology, environmental and legal factors present in the sector.

- *Political stability*: the sector's operations are located everywhere on a global scale and have to face many political barriers. Unstable political conditions may lead to price increases and economic growth degradation, among many other issues.
- *Economic stability*: if stability is missing, the consequences can be a big financial crisis in terms of liquidity and solvency, not to mention risks of noncompliance with suppliers' and consumers' requirements.
- *Stakeholder pressure*: the whole external environment, made for example of employees, suppliers and distributors, can have a huge impact on cost and quality of the products.
- *Competition*: being between different groups of companies or against alternative forms of energy, the development of new and advanced technologies to prevail in the sector may be time consuming and cost intensive.
- *Energy transition*: the industry is starting to shift to new sources, but this has still an uncertain outcome and final effect, thus an unclear impact on products and services offered.
- *Regulations*: as the number of countries involved in the operations is very high, oil and gas industries have to face different regulations and risks and comply with a high number of diverse rules.

Aside from the impact of all these forces on the market, after the initiation of the energy transition, it is expected a big effect on the demand side. Historical data on previous

energy transition, as a matter of fact, shows that changes in the supply side (in this case the introduction of new energy sources) often lead to new sources of energy demand, and finally to an energy demand growth (*Fattouh et al., 2019*).

From this brief overview, it is clear the number of factors affecting the energy market is very high and it is rather difficult to centre on a single one as they are all interconnected with each other. Future predictions, however, focus the attention on an expected change on the demand side, and this is the motive behind the choice of keeping the focus of the analysis in the following chapter on consumers and their preferences.

4.2. Importance of consumers in the energy sector

Consumers are one fundamental part of the economy. Without demand, the supply would not exist, and it is exactly what consumers want and require that shapes what companies can provide and the ways in which they offer products and services.

Aside from all the economic and political factors affecting the energy sector, as a matter of fact, the importance of consumers is undeniable. Households spend a substantial share of their income on utility services such as electricity, heating, and water. The global energy system is a major economic sector with a share of around 8% in Global gross Domestic Product (GDP) and the prospects for improvement are still significant for all economies all over the world (*Ram et al., 2019*).

If people's presence is important for the general provision of goods and services, it is even more important when topics such as sustainability come into the picture.

Scientists and policymakers are increasingly believing that climate change can be considered a consumers' behaviour issue: decisions of what to buy, how much to buy, how much to consume and how to dispose, directly impact the environment and future generations (*Trudel, 2019*). The choices, preferences and behaviours of consumers are directly influencing energy demand and are shaping the acceptability and effectiveness of technologies, and of the strategies and policies created to allow a smooth and sustainable energy transition (*Steg et al., 2018*).

As *Balova et al. (2019)* write, an energy market consumer should become an "active consumer", being capable of optimising its energy consumption.

Energy projects aimed at creating a sustainable energy transition, moreover, can trigger strong negative emotions and resistance from the public.

As *Perlaviciute et al. (2018)* state, “the United Nations-led regulatory framework for environmental projects established by the Aarhus Convention emphasises that citizens have a right to be informed about and comment on environmental decisions and that their comments will be taken into account in decision making. Public engagement and support are crucial for realising sustainable energy projects that are necessary steps toward the Paris Agreement’s goal [...]”. The European Union puts consumers at the centre of the transition, allowing them to take active part in it, creating a bottom-up approach and an “energy democracy” (*Krug and Di Nucci, 2020*).

The energy transition requires big changes in people’s behaviour, such as the adoption of new renewable sources, the use of innovative technologies, and the adoption of energy-saving behaviours. For this reason, it is fundamental to include consumers and their choices in all the analysis related to the energy transition, expecting substantial changes from their part but as well providing them with benefits and useful information to assure their effort is not wasted but rather the opposite.

To this day, knowledge of what sustainable behaviour is and how to shape decision-making around it, is a developing topic, with still a long way to go (*Trudel, 2019*).

Nonetheless, as *White et al. (2019)* believe, if companies are able to adapt their production methods around the changes coming from the demand side, including for example the need for more sustainable practices, they will be more likely to survive on a long term time perspective and enjoy the strategic benefits; not to mention the fact that creating the basis for a positive impact on consumer’s view on the respective business can increase profitability and consumer’s loyalty.

4.3. Consumer’s behaviour in energy consumption

According to *Steg et al. (2018)*, people’s behaviour can be driven by two different types of factors:

- On one side there are the *individual factors*, such as values, identity, beliefs and norms. Individuals must know their energy consumption habits and how the change in these can positively affect the energy transition. As well, they must be motivated and have proper goals and values they believe in to influence their behaviour.

- On the other side there are *contextual factors*, such as economic or cultural factors, institutions, or access to technologies and products. Apart from directly influencing the opportunities or constraints a person has, these factors also shape the time and effort required, the convenience and the social approval or disapproval of behaviours.

Consumers, as said, are required to modify their approach towards energy systems to help the implementation of the energy transition.

Behaviours can have different timescales. Some changes can be implemented very quickly, such as taking shorter showers, avoiding cars for short distances or turning off the light when not needed. Others, on the other hand, require more time, such as the replacement of the technologies in the respective houses and most of all the acceptance of these in new lifestyles (*Steg et al., 2018*).

Apart from the behaviour of the single consumer as a person, its role as a citizen is as well fundamental: political choices can influence the adoption or discard of specific policies and the collective reactions on new facilities and technologies can influence their implementation.

As a more concrete analysis, *White et al. (2019)* define the SHIFT framework, namely the need to consider how Social influence, Habit formation, Individual self, Feeling and cognition and Tangibility can be addressed to move into a more sustainable behaviour.

Social influence refers to the presence, behaviour or expectations that other individuals project on a person. Examples are social norms, meaning beliefs about what is socially accepted and approved in a particular context; social identities, coming from the belonging to social groups; and social desirability, reflecting the need to make positive impressions on other people.

Habit formation means the need to include new sustainable behaviours in routine habits. This can happen spontaneously, thanks only to the will of the specific person, or even as a consequence of penalties or incentives following a specific behaviour.

Individual self refers to some of the factors related to the image that a person has of himself, which are able to influence consumer's behaviour. People want to see themselves in a positive way and feel good about their actions, maintaining a consistent and coherent behaviour throughout the process.

Feelings and cognition are concepts referring to emotions that can be either positive or negative and that influence environmental behaviours.

Finally, *tangibility* is a thought highlighting the fact that all sustainable actions are actually difficult to see, as they are not easy to track, mostly vague and only visible in the future. People need some concrete outcomes to believe they are doing the right thing to reach the wanted results.

As this section explained, then, many are the factors influencing consumer's behaviour and their willingness to shift towards more sustainable practices. It should be clear how fundamental it is the attention of the companies or entities on these multiple aspects to address in the proper way sustainable practices, as well as to voice in the proper way people's concerns, and to be able to focus mostly on the main aspects influencing a person's decisions.

4.4. Beating consumer's psychological barriers

As stated, for all energy projects, in particular the energy transition, people have to employ the right technologies and adopt the correct behaviours towards energy use and consumption, adjusting to new forms of energy supply and reducing energy demand. The energy transition requires a huge public support, so it is fundamental to understand what drives public acceptability of energy projects and to integrate this knowledge into all phases of the implementation.

Following *Perlaviciute et al. (2018)* study, public acceptability can be defined as the extent to which people favour energy projects. Many are the responses that can come from consumers in this context; examples are resistance, uncertainty or apathy, but also acceptance, support and embracement. Social acceptance can be influenced by factors such as people's perception of associated environmental and health impact, visual impact on landscapes, noise pollution, loss of land and real property value, among many (*Krug and Di Nucci, 2020*).

To shape these responses and try to make people as dedicated as possible to sustainability topics, many are the responses that companies can adopt to increase public acceptability, beating in some ways the negative thoughts and trying to reduce people's psychological barriers.

Consumers who object to energy projects are labelled as NIMBY, namely Not In My Back Yard. The assumption behind this naming considers these people to have some negative characteristics, such as selfishness, irrationality or ignorance, that make them not

interested in anything related to an energy transition. Following this assumption, some of the responses taken by companies to increase public acceptability aim at these negative characteristics. Among many, sticking to the policy context, *Steg et al. (2018)* propose some solutions that may encourage sustainable energy behaviour and remove psychological barriers. Policies and programs could, in fact, compensate for behaviours resulting in reduction of fossil energy use, as well as facilitate further changes to reach the goal of having sustainable energy systems.

The first strategy is defined as changing the context: it is required by policy makers to directly engage with individuals that will be most affected by the change, so that the barriers can be understood and discharged while building the change. People bearing the majority of the risks and costs of energy projects can be compensated through some financial incentives, for example better public transport infrastructures but also subsidies or taxes.

A second approach refers to using techniques focused on the selfish interests of people. People may believe shifting towards a more sustainable behaviour is mostly an increase in the effort and basically only a cost for them. By receiving some positive signals about the transition, people can be proud of being part of renewable initiatives and focus on the positive repercussions their acts have.

A third strategy is to show the benefits the transition has on the environment, to increase people's awareness and willingness to support it. Motivation is at the basis of every human action and it may help if people are acting specifically to protect the environment, thus on something they truly believe in.

In addition to that, one of the most important factors influencing consumer's choices is knowledge. Clearly, people asked to completely change their lifestyles could be more motivated if they could see some positive result coming from their actions. Lack of short-term results or concrete outcomes, so far seems one of the main downsides of the acceptability of the energy transitions. People need to have more information about the pros, cons and steps of the process. Having a better understanding about the benefits of the projects may increase people's awareness and thus their acceptability.

At the same time, it is very important to focus the attention on the need for and urgency of a sustainable energy transition, to spread understanding and responsiveness, as it is still very much not known what is happening and why.

Finally, it is also well known that, by nature, people are inclined to resist change. Consumers need time to get used to new ways of living and, many times, accept change only when they have no other choice but to get used to it. A final technique may be for companies or policy makers to implement part of the change and find a way to make people accept it.

As a downside, a common problem when dealing with consumers is believing that there is one solution that goes well in many different situations. This is not the case, especially for energy projects that operate in different community structures, locations and cultures (*Perlaviciute et al., 2018*). Tailored approaches are needed, where all the individual and sociocultural differences are taken into account.

Companies need to study carefully the consumers they are dealing with, their requests and their opinions, especially in periods of change where it is required a big effort from their part to adapt to something still new and unknown.

4.5. (In)justices and (un)fairness

“Partly as a result of our consumption patterns, society and business are confronted with a confluence of factors, including environmental degradation, pollution, and climate change; increasing social inequality and poverty; and the growing need for renewable sources of energy” (*White et al., 2019*).

Keeping the focus on the social inequalities factors above mentioned, as well *Carley and Konisky (2020)*, in relation to the energy transition, state: “without specific efforts made to ensure an equitable transition, not everyone will benefit equally”. Even if the energy transition is one important step in today’s sustainable world, it is also true that there are still a lot of inequalities associated with this transformation.

Transitions, in general, always produce winners and losers, and for the energy sector in particular, disparities may be present in the distribution of benefits and burdens from the change, as well as in the opportunities for engagement and leadership.

The prevalent concept in this context is the one of energy justice and it is based on the notion that “all individuals should have access to energy that is affordable, safe, sustainable and able to sustain a decent lifestyle, as well as the opportunity to participate in and lead energy decision-making processes with the authority to make

change” (*Carley and Konisky, 2020*). Based on this idea, the perfect energy framework should be inclusive and accessible for everyone, as well as transparent and accountable. Following *Carley and Konisky (2020)* analysis, two are the main ways in which the energy transition is adversely affecting individuals, households and communities across the world.

1. Disproportionate burden

This idea reflects the fact that facilities or infrastructures are negatively affecting those located near them. Examples are noise disruptions, unpleasant smells, traffic or air pollution.

2. Lack of access to energy transition opportunities

It seems that access to low-carbon and efficient technologies that accompany the energy transition is not universal and mostly favouring people with higher income. It can be thought for example about the cases for electric vehicles or solar photovoltaic panels, which have rather high initial costs and are not accessible for everyone. Also, the above-mentioned possibility of having higher costs of energy in the first period, due to the necessity of covering the initial investments for new infrastructures and technologies, will for sure impact more people that do not have extra income to absorb higher bills.

Still, even if these two problems are real and may create injustices or inequalities, it is important to focus on the well-established environmental and health benefits of a shift away from extraction and use of fossil fuels, meaning the big positive impact of the transition. Clearly, solutions should be found to make it as smooth and as fair for everyone as possible.

For both of the above disparities affecting people in the energy transition, as a matter of fact, there are some efforts that may help solving them, at least in part. Examples are: assistance programs, to improve the affordability of energy services through bill subsidies and other types of economic support; technology access programmes, to build energy efficient and renewable energy infrastructures that can be extended also to marginalised communities; collective action initiatives, to spread awareness on the environmental issues and the benefits of the transition.

What can be seen is that the implementation of the energy transition in the social sphere of a society is quite challenging but as well there is a lot of room for improvement and endless opportunities for moving forward and making the transition

a positive experience for everyone facing it. What is important is to understand people's needs and situations and find solutions able to benefit the biggest number of affected people as possible.

To conclude, at the basis of every industry there are a supply and a demand side, clearly interconnected between them. What is offered must be in accordance with what is demanded, and the ways in which products and services are provided must comply with the requirements of who is making use of them. For this reason, the consumer side of the market is taken into consideration and analysed in detail.

The transition in the energy sector is a burning topic for consumers, as they spend an enormous part of their income on utility services, and every change, even if small, is felt by everyone, no matter the income or the social status.

In the context of the energy transition, consumers are required to change their behaviour and habits in favour of more sustainable conducts, becoming truly active in the transformation. For this reason, it is important to listen to them and include their concerns in every step of the way.

Consumers' responses depend on different factors being these individuals, thus related to the single person, or contextual, given by the precise environment one finds itself in.

If different are the psychological barriers among consumers, and many are the changes a person can implement in his life to become a sustainable consumer, numerous are as well the remedies that can be adopted by external agents to ease the acceptability of the energy transition.

It is clear that the energy industry is operating in a variety of different contexts and realities, creating differences and injustices among people. This implies the need to carefully study each single situation and to avoid the adoption of one single solution. What may work in one framework can have a completely different outcome in another.

The conclusion is that the possible next steps are many, and room for improvement is enormous. What cannot be changed is how fundamental it is to have consumers on board when making decisions and to make them conscious and aware of the importance of the transition.

5. Consumer's behaviour: survey and data analysis

As discussed in the previous sections, consumers are fundamental in the energy transition as their behaviour is currently affecting many environmental issues, and the possibility of changing it into a more sustainable one can bring important benefits in today's world. With the big effort required from people in a transition, it comes a number of doubts and uncertainties as well they may have in relation to it. It has been seen that psychological barriers may influence the way of approaching the energy transition and the behaviours related to the specific use of new products and services offered.

To study more in detail these skeptical opinions, a survey was offered to some subjects and the answers were collected and analysed. The purpose of the project is to understand how some personal characteristics, such as age, gender, educational background or the yearly income, can influence the idea a person has on the energy transition. More in detail, after some general personal questions needed to shape the sample, and some others related to general sustainability topics, five statements connected to the main issues surrounding the transition have been proposed. The subject had to state the level of agreement or disagreement with respect to them.

The answers have then been studied through an ordinal logistic regression, making use of a mathematical software that allowed to include the effect that some personal factors may have on the main variables considered.

In this chapter there will be first a general introduction of the survey, with the aim to explain where, how and why this questionnaire was proposed and how it was structured.

In the second part, the data collected through the answers is presented, specifying the coverage of the sample on different factors and focusing as well on how many people gave certain answers or what are the interesting findings that come out of them.

The following section explains in detail which are the five factors considered as dependent variables and the reasons behind this choice.

After that, a short theoretical part on ordinal logistic regressions is presented, to make it clear how this mathematical procedure works and why this particular model was chosen.

Finally, it is offered a concrete elaboration of the model on the data collected, with examples and the specific numeric values obtained, to be able to get some insights and conclusions from it.

5.1. Questionnaire: structure and scope of research

The survey hereafter analysed and proposed to people, wants to understand how and whether some personal factors, such as age, gender, income or educational background, can affect a person's view and feelings about the energy transition.

The questionnaire was divided into five sections:

1. General personal information

The first part was aimed at collecting some information about the socio – economic situation of the subject. Questions were asked about the geographical location in which the subject was at that moment, the gender, the age, the educational background, the occupation or the average yearly income.

2. Sustainability topics

The second part wanted to collect information about the general opinion of the people on sustainability. Examples of questions proposed were whether they are interested in sustainability topics, how they learn about the subject or if they think of themselves as sustainable consumers.

3. Energy transition

The following section was focused on the transition and its aim was to understand whether the subject knows what it is, how it can be defined and what are believed to be the main advantages or disadvantages of this transformation process.

4. Oil and gas industry

This part consisted of some personal opinions in relation to specific statements proposed. It was focused on the oil and gas industry, its success in the transformation, and its future after the energy transition.

5. People's thoughts and beliefs on the transition

The last part was related to some of the factors that may influence the willingness to accept the energy transition and to adopt behaviours favouring a smooth transformation. Examples of factors proposed are the probable increase

in prices of the products and services provided, the efficiency of the new technologies implemented, or the need to have more reliable and clear data.

Data was collected in person, with face-to-face interviews, and online, after sharing a link connecting to Google Form. The survey consisted mostly of closed questions, where some answers were proposed and the person had to select one among them. Where needed, there was the possibility of adding some personal comments to the predefined answers. In all the questions a response was required.

The fulfilment of the survey was purely voluntary, proposed to all types of energy consumers and the data was treated in an anonymous way all the way through the project.

5.2. Description of the sample

5.2.1. Part I: general personal information

The questionnaire was proposed to 101 subjects of different ages, with diverse backgrounds and geographical locations, in order to have a sample as complete as possible. The physical interviews were collected mainly in Italy and Austria in public places such as universities, shopping centres or squares, while the online version was shared among colleagues, friends and their acquaintances; the answers provide both for people's socio – economic information and for personal opinions about the topic.

The majority of the interviews were collected in Italy and Austria, respectively 46% and 36%. People from other European countries, such as Spain, Germany or France were interviewed as well. A small percentage of questions, 4% of the total, were answered from people located in non-European countries.

As per the gender, the sample is quite evenly divided between males and females, with a total of approximately 50% answers per each group.

Concerning age, the sample covers consistently all the four age-groups created for simplicity and clarity: 37% are between 0 and 25 years old, 44% are between 26 and 50 years old, 18% between 51 and 75 and finally 2% have more than 75 years.

Regarding the educational background, the sample is quite evenly divided between people with a high school degree (30%), a Bachelor's degree (28%) and a Master's degree (33%). Smaller percentages represent people with a pre-high school degree (3%) and with a PhD or other post-Master's degree (7%).

The majority of the people interviewed are students or employees, respectively 32% and 41%. Fewer ones are self-employed workers, retired, managers or unemployed.

The last personal information requested was in relation to the average yearly income. The majority of the interviewed people (53%) earn less than 30.000 euros, two subgroups, of similar size between them, respectively 19% and 23%, earn from 30.000 to 70.000 euros and from 70.000 to 100.000 euros. Finally, a small part of the sample, precisely the 5%, earns more than 100.000 euros.

5.2.2. Part II: sustainability topics

In relation to sustainability, a meaningful discovery was the fact that almost everyone participating in the interview is interested in topics related to it. 51 answers declared people are very concerned and are trying to be as informed as possible when making decisions. 46 people have expressed an interest in sustainability but not so big as to influence the decisions. Only 4 people out of 101 declared they do not know or do not care about it.

The majority of the people (59%) learn about sustainability or similar topics by reading articles or listening to the news, even though there are many subjects who would rather ask information to someone that works in the field and is more informed. 12% of the interviewed people stated they do not do any type of research.

As the majority of the answers reported a high interest in sustainability topics, coherent data was collected in relation to the feeling of being sustainable consumers. More than 70% of the subjects answered they believe to be sustainable consumers as they focus their attention on what they are buying, even though other constraints may make the choice a bit difficult. Summed to that, 8% of the answers were of people believing to be a sustainable consumer as they only buy sustainable products. The remaining part of the sample, however, does not put too much care on how the product or service bought was made or where it comes from, or not enough to make it an influential factor in their buying decisions.

5.2.3. Part III: energy transition

In the survey, some questions were asked to understand people's opinion on the energy transition. The answers revealed that 71% of the sample knows what it is, while the remaining 29% does not.

Following the theory explained in the previous chapters and the literature around the topic, four definitions of energy transition were proposed for the person to choose among. Results show that 51% of the people think of the transition as an environmental issue, thus a solution created to ease and solve the increasing environmental problems. 18% believe it is more a political topic, so an obligation companies have to follow to comply with new rules and requirements. 16% view it as a social issue: a transformation created because of the shift in consumer's preferences. Finally, 14% of the sample thinks it may be more a company strategic issue where entities are deciding to shift to new forms of energy production for their own benefit.

People were asked as well what they believe to be the main advantages and disadvantages of the energy transition.

As per the advantages, the biggest one recognized is the positive impact it could have on the environment (66% of the answers), followed by the benefits that may derive from the development and introduction of new technologies and practices (21%).

On the other hand, the two main disadvantages recognized against the energy transition are the possibility of having more expensive and lower performing products, and the problem of not knowing what the result could be due to the long time period required to see some results, represented respectively by the 27% and the 26% of the sample. These are immediately followed by an elevated number of people having a feeling of distrust towards new forms of energy that are unknown and very different from the old ones. Nonetheless, 62% of the people still stated they would be keener to buy products from a company knowing it has started an energy transition.

5.2.4. Part IV: oil and gas sector

The fourth section of the questionnaire was focused on the oil and gas sector and was based on some of the main concerns people have in this period of change.

81 people out of 101 totally or partially agreed on the fact that this industry is perceived as one of the least sustainable ones.

However, a total of 62 subjects believe it can potentially shift to more sustainable practices and 70 out of all think it will not disappear after the transformation.

The last question proposed was the most inconclusive. The statement tested whether the industry could succeed in the transition. 49 people totally or partially disagreed, while 52 totally or partially agreed, leaving an almost equal split between positive and negative perceptions.

5.3. Description of the factors considered

The last section of the survey contained the five factors needed to create a mathematical model hereafter elaborated. The definition of these factors came from a deep analysis of the bibliography on the topic, as well as from inspiration taken out of discussion with people more or less involved and interested in the transformation.

These factors wanted to highlight some of the most important doubts and uncertainties a consumer can have in relation to the energy transition, as well as common worries that may stop a person from fully believing this is the right way to go in the future.

One of the biggest dilemmas, as it has been seen also in the answers from the previous parts of the survey, is the possibility of having to face higher costs for the energy products and services used. Higher costs may come from the need of a company to compensate for the initial investments for new technologies and research, or the expenses the businesses have to face for the transformation when transitioning to new forms of production. Clearly, the increase in costs is an important topic that may prevent a person from fully engaging in the shift to new products or services offered. The feelings related to the possibility of having to face increasing costs may depend on the level of income a person receives: the lower it is, the less “extra money” the subject has to cover higher costs. On the other hand, the more a person earns, the more he can be able to face a bigger investment in the product or services used. As well, the level of interest on the energy transition and the general knowledge on the topic may be important factors. A person understanding its importance and how the process works may be more willing to invest in it than a person not aware of the benefits it may bring.

A second issue, as explained in the previous theoretical chapters, is the lack of clear and defined data. If a consumer does not know exactly what is going on, what a company is doing or plans to do, and what the future steps are, it may be more difficult for him to

believe in and support the transition. This factor may be related to the occupation or the education level, as people who want to see actual data usually need some deeper understanding of the topic, and the ability to properly interpret the numbers and the information they see.

In relation to the previous topic, also the difficulty of getting some tangible and concrete results can be a problem for a consumer. Every person has to invest a lot of time, energy and money to be fully engaged in the energy transition. If it seems almost impossible to see whether these make any difference or not, this may discourage a person to keep going in this direction. An influencing factor in this context can be again the knowledge of what the energy transition is and how it works, that may lead people less informed to give up earlier as they may not see the purpose of moving forward.

The next factor considered is related to doubts a person may have in relation to new forms of production and the use of new technologies. Change always means learning how to use new unknown instruments and how to find a way to insert them in a new lifestyle. This may be scary and may prevent people from fully trusting the process. Influencing factors could be age, as the older a person gets, the more difficult it is to adapt to change and new technologies. New tools may also concern people with regards to the economic aspect, as they usually are perceived as expensive to buy or implement. The expectation is, then, that this issue may be influenced by a person's income level. As well, understanding how new technologies work, due to experience in the sector or previous knowledge, may help accepting its implementation. Education and occupation can be influencing factors, too.

The fifth and last factor is of course related to the importance the environment has -or does not have- on a person's life. Clearly, the more a person is dedicated and concerned about the environment, the more he will be willing to do everything possible to ease the situation. On the other hand, if a person is not really involved in sustainability and other environmental topics, he may not be as motivated to fully immerse himself in the energy transition. This topic may be influenced by the geographical location where a person is situated, due to a different perception on the environmental condition.

The five factors above presented will be treated as dependent variables on which the regressions will be built. They can take one of the four outcomes spacing from totally disagree to totally agree. The mathematical model proposed in the next section wants to

see and predict how these outcomes may depend on specific information about the person, such as the age, the gender or the average income.

5.4. Description of the mathematical procedure

5.4.1. Ordinal Logistic Regressions

The data collected has been analysed through ordinal logistic regressions, also referred to as ordinal logit regression, used to predict the probabilities of the different outcomes on the statements proposed. The data was analysed using the software R.

This type of regression was chosen as it allows to model an ordered categorical variable (y) using one or more other variables (x s).

As part of the reason for implementing this type of ordinal logit regression, it can be stated that alternative methods, such as the widely used Ordinary Least squares (OLS) or other linear models, are based on strong statistical assumptions difficult to find in more dynamic contexts like this one.

The benefit of using this type of regression is clearly the possibility of modelling different explanatory variables on a dependent one with different outcomes. A second advantage, moreover, is the fact that the outcomes for the dependent variable have to be ordered, and this is exactly the case for the data collected where the results can space from “Totally agree” to “Totally disagree”, thus in a high – to – low scale. Ordered variable means, in fact, that it can take subsequent values on an arbitrary scale.

Ordinal logistic regressions are useful and used if the aim is to see how a variable can help predict another one and the categories are three or more with a natural ordering. An example of use of the OLR can be found in sectors such as the medical one, where the factors studied may have ordered outcomes like “good”, “stable”, “serious” and “critical”. When using an ordinal logistic regression, some conditions must be ensured in order to have a valid outcome. The most important assumptions are the following:

- *Linearity*: the relationship between the natural log of the probabilities associated with each outcome and the predictor variable should be linear;
- *No outliers*: there should be no outliers or influencing points;
- *Independence*: the value of every variable should be independent from the value of the others;

- *No multicollinearity*: the independent variables should not be correlated with each other.

As concerns the mathematical description of the model, the basis of the explanation starts with the idea of having an independent variable, y , which can take j ordinal outcomes or ordered categories. What has to be found is the cumulative probability $P(y \leq j)$, thus the probability of y being less or equal to a specific category $j = 1, \dots, j - 1$. In general, it means that the probability of an event is considered in comparison to all the events that are ordered before it.

The odds of being less than or equal to a particular category are defined as

$$\frac{P(y \leq j)}{P(y > j)} \text{ for } j = 1, \dots, j - 1.$$

As the mathematical procedure finds first the *log odds* of the regression, the formula becomes:

$$\log \frac{P(y \leq j)}{P(y > j)} = \text{logit}(P(y \leq j)).$$

The regression associated with this model is run on all the parameters. The parameters are the independent variables, x s, that are M in total. In general:

$$\text{logit}(P(y \leq j)) = \beta_j - \sum \eta_i x_i = \beta_{j0} - \eta_1 x_1 - \dots - \eta_M x_M$$

where $j = 1, \dots, j - 1$ and $i = 1, \dots, M$.

In the equation, β is the intercept of the regression, meaning the point where the dependent variable is cut in order to divide the sample in the sub-groups needed; η is the value of the coefficient for each independent variable; the x s are the M independent variables.

The five dependent variables chosen, the y s in the model, as described in the previous section, are:

1. *Q1*: The person would be willing to support the transition even if it means paying higher prices;
2. *Q2*: The person would be more willing to support the transition if it was easier to have some clear data related to it;
3. *Q3*: The person would be more willing to support the transition if it was easier to get some short-term tangible results;

4. *Q4*: The person would be reluctant to support the transition because of growing uncertainty and distrust towards new technologies;
5. *Q5*: The person would be willing to support the transition because it would ease the climate and environmental problem.

These five variables may take one out of the following four values: “Totally disagree”, “Partially disagree”, “Partially agree” or “Totally agree”.

To be highlighted is the fact that, as the independent variables may as well take different outcomes, for each of them it is chosen a reference level that is then compared with all the others. This means that the total number of outcomes in the output is actually the *total number of possible outcomes* – 1. For example, if Geography has possible outcomes “Italy”, “Other European country” and “Non-European country”, thus $k = 3$, the first one would be chosen as reference and the regression will compare to it the other two (*total number of outcomes* = $3 - 1 = 2$). The list of variables used in the model, a brief description and their possible outcomes can be found in Table 1.

Variable	Description	Possible outcomes
Geography	The geographical location in which the interview was collected	Italy (ref.level)
		Other EU country
		Non-EU country
Gender	The gender of the person	Female (ref.level)
		Male
Age	The age, in numbers, of the subject	1st group: 0-25 (ref.level)
		2nd group: 26-50
		3rd group: 51-90
Education	Level of education the person has at the moment the questionnaire was collected	Pre- or High school degree
		Bachelor's degree (ref.level)
		Master's or Post-Master's degree
Occupation	The profession exercised	Student
		Employee (ref.level)
		Other
Income	Average yearly income level	<30.000 Eur (ref.level)
		30.000-70.000 Eur
		70.000+ Eur
Interest	Level of interest and of influence that sustainability topics have on a person's life	Interested that influences the decisions
		Interested but this does not influence the decisions
		Not interested (ref.level)
Knowledge	Previous knowledge about what the energy transition is and how it works	Yes
		No (ref.level)

Table 1: Independent variables used, their description and the possible outcomes they may take

5.4.2. Model implementation in R

To implement the model, the responses can be imported in the software and analysed. For simplicity, all the possible outcomes are converted into factors and the dependent variable is defined as ordinal. It is helpful, in this part, to look at the structure and the summary of the data before and after the conversions, to see if the values have been properly imported and can be used to build the model.

After these adjustments, the first step is to construct a general model containing a regression of the dependent variable on all the independent variables. The outcome from the system is a table with the values for all the coefficients and the intercepts, the standard errors and their t-values. For completeness, it is worth mentioning that the t-value represents the ratio between the value of the coefficient and its standard error.

5.4.3. 2-tailed Z-test

The next step in the procedure is to understand which of these variables are statistically significant and give an important contribution to the model. To do that, the following stage is the implementation of a *2-tailed Z-test*. This statistical test is chosen instead of the other statistical tests as the sample is large enough and the population variance can be found.

The test checks the deviation of the mean of each independent variable from the mean of a standard deviation. The null and alternative hypotheses are respectively

$$H_0: \mu = \mu_0 \text{ and } H_1: \mu \neq \mu_0.$$

Then, the value for $z_{critical}$ has to be found, considering that $P(Z \leq z_{critical}) = 1 - \frac{\alpha}{2}$.

α represents the probability of a value to be outside the acceptance region, meaning the probability of rejecting the null hypothesis; it is divided by 2 because the test is bidirectional. Assuming a confidence region of 90%, thus a rejection region of 10% and checking the Z-score tables for the result,

$$P(Z \leq z_{critical}) = 1 - \frac{0.1}{2} = 0.95 \rightarrow z_{critical} = 1.645.$$

This means that the rejection region will be below -1.645 and above +1.645.

In order for a coefficient to be significant, it has to fall within the acceptance region. The value that should be located in this area is the z-value and is calculated as $z = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$,

where \bar{x} is the sample mean, μ the population mean, s the population standard deviation and n the sample size. Given the fact that the data pertains to a random sample, the

population is normally distributed and the sample is large, the distribution taken as reference for the test is the normal one, thus with mean zero and standard deviation equal to one.

Then, if z falls inside the acceptance region, the null hypothesis can be accepted. Vice versa, if z falls in the rejection region, H_0 should not be accepted.

As stated, the level of confidence assumed in this case is 90%, thus, for a significant coefficient, the p-value should be lower or equal to 0.1. By comparing this value to the ones obtained, it is possible to understand which variables are significantly contributing to the model and which are not. The variables not statistically significant can be excluded and the others can be used to write the final model. The next step is then to write a new model including only the significant coefficients.

As for the interpretation of the results, the value of the coefficient will represent the expected increase or decrease of the y , given a one unit increase in the variable considered, keeping all the other variables constant.

5.4.4. Confidence intervals and coefficients

The last part for the model implementation is the calculation of the confidence intervals for the parameters estimated. These represent the range of values in which the variable can be found. To do this, there are two ways to proceed: on one side, the calculation can be based only on the model data, making use of the likelihood function – the probability of a random variable to appear in the given data set; on the other, the segment can be calculated assuming normality, thus using default values. The expectation is for all the significant variables not to contain zero inside the interval.

Once this is done, the proof that all the variables considered are statistically significant is given. The last step is then to build the final model calculating the exponential value of the coefficients. As mentioned before, this must be done because the values previously found represent the log – odds of the probability of a variable in relation to another one; this calculation allows finding the proportional odd ratio.

These procedures, now explained in a theoretical manner, are applied to all the dependent variables chosen, namely Q1, Q2, Q3, Q4 and Q5. The numerical results and respective conclusions and comments are reported in the following sections.

5.5. Analysing the results

5.5.1. Regression and comments on Q1

The first statement asked people whether they would believe in and support the energy transition given the possibility of having to pay more for goods and services. After all the adjustments needed to build the regression, the results of all the variables can be seen in Table 2.

Variable	Value	Std. Error	t-value	p-value
Geography (ref.level: Italy)				
Non-EU country	-0,2740	0,8095	-0,3384	0,7350
Other EU country	-0,5061	0,5575	-0,9077	0,3640
Gender (ref.level: Female)				
Male	-0,2446	0,4312	-0,5672	0,5706
Age (ref.level: 1st)				
2nd	-0,6798	0,5787	-1,1747	0,2401
3rd	-1,2224	0,6933	-1,7630	0,0779
Education (ref.level: Bachelor's Degree)				
Maste's or Post-Master's Degree	0,1971	0,5305	0,3714	0,7103
Pre- or High school Degree	-0,3527	0,5716	-0,6170	0,5372
Occupation (ref.level: Employee)				
Other	-0,2494	0,5954	-0,4188	0,6754
Student	0,0765	0,6212	0,1232	0,9019
Income (ref.level: <30.000euros)				
30.000-70.000euros	1,9528	0,6017	3,2455	0,0012
70.000+euros	1,7616	0,6425	2,7417	0,0061
Interest (ref.level: Not interested)				
Yes, influencing decisions	1,8531	1,0921	1,6968	0,0897
Yes, non influencing decision	1,4849	1,0652	1,3940	0,1663
Knowledge (ref.level: No)				
Yes	1,3237	0,4763	2,7793	0,0054
Totally disagree Partially disagree	0,8285	1,3923	0,5950	0,5518
Partially disagree Partially agree	2,3397	1,4076	1,6622	0,0965
Partially agree Totally agree	4,0428	1,4378	2,8117	0,0049

Table 2: Results of the regression on Q1 considering all the variables

The analysis of the p-values allows to see that not all the variables are statistically significant. Geography, Gender, Education and Occupation can be excluded as their p-values are higher than 0.1. To be noted is that if a variable has two outcomes, one non significant and the other significant, the variable should be kept in the model. For example, Age's outcome "2nd" has a p-value higher than 0.1; as the outcome "3rd" is significant, however, age is not excluded from the regression.

As previously theoretically described, the model now obtained contains the significant values and the numerical values for the log-odds of their probability. Again, the coefficients can be interpreted in the following way: for 1 unit increase in Age 2nd, it is estimated a 0.6798 decrease in the expected value of Q1, given all the other variables constant. The exponential values can then be calculated in order to properly write the final equation, and the significance interval should be found as well.

The coefficients would indicate that, for example, a person in the second age group is related to a higher likelihood of having a positive approach towards the price increase as opposed to a person in the first age group. This same reasoning can be applied for all the other coefficients.

As for the intercepts, $P(\text{Totally disagree}|\text{Partially disagree})$ represents the odds of totally disagreeing on the sentence versus all the other possibilities.

The most interesting conclusion that derives from these regressions is that people in the second and third band of average income are more likely to accept an increase in the prices of goods and services as compared to the ones in the first group. The explanation can be due to the fact that people with a lower income may have less financial freedom to be able to spend a higher proportion of their salary on products and services, thus are less willing to accept a price increase.

As well, significant variables were the level of interest and of knowledge on energy transition topics. It seems the more people are informed and care about the transition, the more they would support the change even if it means paying higher prices. This is coherent with the hypothesis, as it was predicted that being involved or informed on the topic might lead to a bigger engagement in actions related to it.

5.5.2 Regression and comments on Q2

The second question wanted to understand if some personal factors are affecting the willingness of people to support the transition, given more clear and reliable data about it. This statement was proposed as it has been seen that, for the majority of the consumers, the energy transition seems still to be an unknown topic for which they have no real proof of what is happening or ways of checking the information received.

The results are shown in Table 3.

Variable	Value	Std. Error	t-value	p-value
Geography (ref.level: Italy)				
Non-EU country	-0,2159	0,8024	-0,2690	0,7879
Other EU country	0,5992	0,5876	1,0197	0,3079
Gender (ref.level: Female)				
Male	-0,1631	0,4637	-0,3518	0,7250
Age (ref.level: 1st)				
2nd	-1,1430	0,6007	-1,9029	0,0571
3rd	-1,0296	0,6918	-1,4883	0,1367
Education (ref.level: Bachelor's Degree)				
Maste's or Post-Master's Degree	0,2830	0,5355	0,5284	0,5972
Pre- or High school Degree	-0,3948	0,5703	-0,6922	0,4888
Occupation (ref.level: Employee)				
Other	0,6413	0,5729	1,1194	0,2630
Student	0,1084	0,6266	0,1731	0,8626
Income (ref.level: <30.000euros)				
30.000-70.000euros	0,3754	0,5747	0,6532	0,5136
70.000+euros	-0,0880	0,6219	-0,1415	0,8875
Interest (ref.level: Not interested)				
Yes, influencing decisions	3,0198	1,3089	2,3072	0,0210
Yes, non influencing decision	2,8033	1,3007	2,1552	0,0311
Knowledge (ref.level: No)				
Yes	1,8493	0,4962	3,7269	0,0002
Totally disagree Partially disagree	1,5564	1,5137	1,0282	0,3039
Partially disagree Partially agree	3,3854	1,5560	2,1756	0,0296
Partially agree Totally agree	4,8893	1,5813	3,0919	0,0020

Table 3: Results of the regression on Q2 considering all the variables

Following the procedure, the non-significant coefficients are excluded and the regression can be run again. In this case the variables significant for the model are Age, Interest and Knowledge. On the other hand, Geography, Gender, Education and Occupation have p-values higher than 0.1 and do not provide significant contribution to the regression on Q2.

As expected, then, the main factor positively influencing the regression is the level of interest on the transition. It is clear that, again, the more a person is interested in the topic, the more he requires to have some clear and understandable data. The bigger the interest, the higher the awareness on the topic, and thus the easier the interpretation of the data received. A similar reasoning can be applied to the factor Knowledge: having some previous understanding on the topic can help a person in understanding better the data received and, in the same way, can be better comprehensible if someone knows what it is about.

As for Q1, in this case age again plays an important role in the regressions, highlighting the fact that the older the person, as compared to the first age group, the bigger the necessity to have some clearer and better defined data.

5.5.3. Regression and comments on Q3

The third statement was related to the possibility of having some short – term tangible results. Apart from missing some clear data to make weighted decisions, as mentioned before, one big issue in the energy transition seemed to be the fact that the process is quite long, and results are expected only in the distant future. People may feel discouraged if they cannot see any effect in a short-time frame, giving up before putting too much effort in a topic with an unclear and unknown final result.

Again, Table 4 reports the results of the first model on all the variables.

Variable	Value	Std. Error	t-value	p-value
Geography (ref.level: Italy)				
Non-EU country	-0,3832	0,7701	-0,4976	0,6188
Other EU country	-0,4317	0,5514	-0,7828	0,4337
Gender (ref.level: Female)				
Male	0,3285	0,4472	0,7345	0,4626
Age (ref.level: 1st)				
2nd	1,0049	0,6072	1,6550	0,0979
3rd	1,4399	0,7122	2,0216	0,0432
Education (ref.level: Bachelor's Degree)				
Maste's or Post-Master's Degree	0,3618	0,5209	0,6946	0,4873
Pre- or High school Degree	-0,9027	0,5902	-1,5293	0,1262
Occupation (ref.level: Employee)				
Other	0,2523	0,5701	0,4426	0,6581
Student	0,6401	0,6382	0,9873	0,3235
Income (ref.level: <30.000euros)				
30.000-70.000euros	-0,6301	0,5528	-1,1439	0,2527
70.000+euros	-0,5984	0,6252	-0,9572	0,3383
Interest (ref.level: Not interested)				
Yes, influencing decisions	3,3276	1,2759	2,6091	0,0091
Yes, non influencing decision	4,1451	1,2709	3,2615	0,0011
Knowledge (ref.level: No)				
Yes	0,2520	0,4763	0,5522	0,5808
Totally disagree Partially disagree	1,6981	1,4995	1,1325	0,2574
Partially disagree Partially agree	3,4392	1,5358	2,2394	0,0251
Partially agree Totally agree	5,5986	1,5715	3,5625	0,0004

Table 4: Results of the regression on Q3 considering all the variables

In the case of Q3, the relevant factors seem to be Age and Interest.

The results of this regression are very similar to the previous ones on statement Q2. The questions are in some way related, as it is expected that a person needing to see and to have concrete data on the transition, may also be more willing to see the results of these procedures. This shows a clear pattern where the level of interest and knowledge in the topic and the age of a person, clearly influence the dedication of a consumer in supporting the transition, as well as the requirements that a person has in order to be able to act positively towards it.

5.5.4. Regression and comments on Q4

The fourth statement wanted to understand if people are resistant to change because of a feeling of distrust towards new technologies introduced and new resources used to produce sustainable energy. To be noted is that the statement is proposed with a negative connotation, thus the ordering of the outcomes for the dependent variable has been reversed.

Variable	Value	Std. Error	t-value	p-value
Geography (ref.level: Italy)				
Non-EU country	0,1191	0,8582	0,1388	0,8896
Other EU country	-0,4840	0,5824	-0,8311	0,4059
Gender (ref.level: Female)				
Male	0,4241	0,4626	0,9166	0,3593
Age (ref.level: 1st)				
2nd	-0,8527	0,5850	-1,4577	0,1449
3rd	-0,8263	0,6901	-1,1973	0,2312
Education (ref.level: Bachelor's Degree)				
Maste's or Post-Master's Degree	-0,3635	0,5308	-0,6848	0,4934
Pre- or High school Degree	-0,3135	0,6160	-0,5089	0,6108
Occupation (ref.level: Employee)				
Other	-0,3499	0,5683	-0,6158	0,5381
Student	0,3017	0,6108	0,4940	0,6213
Income (ref.level: <30.000euros)				
30.000-70.000euros	0,4076	0,5829	0,8073	0,4195
70.000+euros	-0,0176	0,6444	-0,0274	0,9782
Interest (ref.level: Not interested)				
Yes, influencing decisions	3,7280	1,3091	2,8478	0,0044
Yes, non influencing decision	3,5097	1,2886	2,7236	0,0065
Knowledge (ref.level: No)				
Yes	1,1024	0,4606	2,3934	0,0167
Totally disagree Partially disagree	0,6164	1,5375	0,4009	0,6885
Partially disagree Partially agree	2,5010	1,5583	1,6050	0,1049
Partially agree Totally agree	4,1212	1,5700	2,6250	0,0087

Table 5: Results of the regression on Q4 considering all the variables

From Table 5 it can be seen that the significant variables for the regression on Q4 are Interest and Knowledge.

As stated for the previous regressions, once more, people that have some interest and knowledge on the topic support more the changing technologies and new solutions proposed, in comparison to those that do not. As it is true that the need to require some data is related to the ability to understand it, the same occurs for the introduction of new unknown technologies. The more a person is informed and open to using modern and different systems, the easier it is to be willing to try them and to accept their presence in a new lifestyle.

5.5.5. Regression and comments on Q5

The last statement in the survey wanted to see whether the positive behaviour of a person towards the energy transition could be linked to a feeling of care towards the environmental situation. Clearly, here the assumption behind the statement is that the more a person cares about the environment, the more he could have a positive feeling about the transition as a mean to help the current situation.

For this case as well, the hypothesis is that the significant variables in the model are Interest and Knowledge, as they definitely relate and influence the commitment a person has in relation to sustainability topics and sustainable consumption actions.

The results are shown in Table 6.

Variable	Value	Std. Error	t-value	p-value
Geography (ref.level: Italy)				
Non-EU country	-0,3384	1,1492	-0,2945	0,7684
Other EU country	0,0972	0,5944	0,1636	0,8701
Gender (ref.level: Female)				
Male	-0,9195	0,4796	-1,9173	0,0552
Age (ref.level: 1st)				
2nd	-0,5260	0,6102	-0,8621	0,3887
3rd	-0,2297	0,7676	-0,2993	0,7647
Education (ref.level: Bachelor's Degree)				
Maste's or Post-Master's Degree	0,4959	0,5710	0,8684	0,3852
Pre- or High school Degree	-0,4512	0,6448	-0,6998	0,4840
Occupation (ref.level: Employee)				
Other	-0,3889	0,5969	-0,6516	0,5147
Student	0,6343	0,6387	0,99317	0,3206
Income (ref.level: <30.000euros)				
30.000-70.000euros	-0,4445	0,5958	-0,7460	0,4557
70.000+euros	-0,3100	0,6508	-0,4763	0,6338
Interest (ref.level: Not interested)				
Yes, influencing decisions	3,1743	1,2553	2,5288	0,0114
Yes, non influencing decision	2,6882	1,2368	2,1735	0,0297
Knowledge (ref.level: No)				
Yes	1,1563	0,4880	2,3694	0,0178
Totally disagree Partially disagree	-1,0084	1,4788	-0,6819	0,4953
Partially disagree Partially agree	1,1728	1,5384	0,7623	0,4459
Partially agree Totally agree	3,0222	1,5449	1,9562	0,0504

Table 6: Results of the regression on Q5 considering all the variables

The regression on Q5 highlights, as expected, that people interested in the transition and with some knowledge about it are agreeing to the statement, showing the willingness to change some behaviours to help the environment. For one more numerical interpretation, it can be seen that: for 1 unit increase in the variable Interest, related to people whose interest on the energy transition is so high as to influence their decisions, there will be a 3.1743 increase in the expected value of Q5, maintain constant all the other variables in the model.

In this regression, an interesting result is that being a male is affecting the result as well as opposite to the answers collected from female subjects.

5.6. Comments

Among the different factors considered, the one that was always significantly influencing the models was the level of interest a person has on the energy transition. It is clear that a person that cares about the process and thinks about his behaviour when making decisions is more involved in the topic in general. As it was shown from the data, the more a person is interested in the topic, the more he is willing to pay higher prices for products and services and the more he is willing to support it, given some conditions. If data was more easy to collect, simpler to analyse and the results could be seen even after a short period of time, then the majority of the people properly informed about the transition would develop a bigger positive feeling towards it.

Another relevant factor was the knowledge about what the transition is and how it works. Again, having some previous knowledge on the topic may help people understand what they are doing and why they are doing it. Being informed means being more willing to support the transition when information is given and when some results are making it real. As well, it means being keener in accepting new technologies and the changed products and services offered.

In the regressions concerning the acceptability to pay higher prices, as expected, the level of income was a relevant factor, too. It is clear that shifting towards new sources of energy consumption and adopting a different lifestyle may bring an increase in general prices, not to mention the increase of the actual prices of products and services. People need financial stability and an average income high enough to be able to change their preferences without sacrificing anything else.

Age seemed to be mostly relevant when the possibility of having clearer and more reliable data and some short-term tangible results were mentioned. It seems that the older a person gets, the more sure he wants to be about what is happening in his life, thus requiring concrete results to be able to make informed and consistent decisions.

Finally, the gender seemed to be relevant especially in the context of being interested in the energy transition because of a deep feeling of care towards the environment.

The significant factors found thanks to the regressions were mostly coherent with the hypothesis made and most of all coherent between them, showing a quite defined pattern when it comes to the reasons behind trust and distrust of the transition process.

In conclusion, it has been seen that people are still skeptical when it comes to the energy transition. Numerous psychological barriers are still strongly blocking people to fully engage with a change in their lifestyles and in accepting new sources of energy or new technologies in that sector.

Through a survey proposed to energy products' consumers, some general considerations were made about sustainability and the energy transition. Answers revealed that people are concerned about the environment, try to be informed and to act as sustainable consumers. However, many doubts about the energy transition appeared, such as the worry of having to pay more for products and services, or the lack of proper information and disclosure of tangible results. When the Oil and Gas sector was taken as an example, half of the people interviewed were not sure about the success of the transformation in this industry.

The survey, however, also showed that people are slowly accepting the transformation, as the majority of people believed the Oil and Gas industry could potentially shift towards more sustainable practices and it will not disappear after the change.

To better analyse what personal factors may influence some feelings about the transition, an ordered logistic regression was fitted into the data model and run on five statements proposed in the questionnaire.

Results show that the most relevant factor is whether a person is actually interested in the transformation and if there is some general previous knowledge about it. As well, given a probable increase in prices to acquire products and services and to shift to new technologies, important seems to be the average income of the person. Finally, it was proved that the older people get, the more they become skeptical towards change and require some clear and defined data for their own personal decisions.

What is clear after the analysis is that the transition has still a long way to go. People still have a lot of doubts about the results and the efficiency of the methodologies proposed, and there are a lot of psychological barriers that have to be demolished for people to be convinced about the benefits it may bring.

6. Conclusion

The analysis presented in this project on the energy transition, the Oil and Gas sector and consumer's thoughts and behaviours, allowed to highlight some important findings. First of all, it seems clear that the energy transition and the shift towards more sustainable practices is now required and it must happen as quickly as possible. However, it is true as well that this topic is still very unknown and not easily understood by people. General concepts of what sustainability is and how to behave in more environmental – friendly ways are still unclear and very blur. Frameworks and guidelines to follow are present but, to this day, they are poorly defined and difficult to interpret.

It has been seen that energy transition is a complicated process to implement, and it brings many challenges both for the companies and for the consumers. This is true in particular for the Oil and Gas sector, as the risks following the transformation's implementation are multiple and should be properly addressed to avoid terrible results. However, many are the ways forward that can be implemented and room for improvement and development is huge.

As big effort is required from the consumers, it has been analysed how people can behave and what are the biggest doubts and uncertainties they may have. Consumers have multiple concerns that should be properly addressed but, again, many are the solutions that can be adopted to make sure people are convinced that the benefits the energy transition could bring are bigger than the challenges to face.

People seem to be concerned about the environment and to try behaving in the most sustainable ways possible. However, many doubts are still present about the energy transition and its effects. Examples are the worry about having to spend more on energy related products and services and the common feeling of distrust towards new unknown technologies.

Factors influencing these opinions are mostly related to the interest a person has on the energy transition and the general previous knowledge about it. Clearly, the more a person is concerned about the environment and is informed about how these transformation practices work, the more he can believe it is the right way to go and the more willing he will be to support it.

Importance can have as well the level of income of the consumer, linked in part to the job position and his level of education, as the possibility of having to pay more for products and services is real and people need some financial stability to be able to afford it without sacrificing anything else.

Moreover, the transition still is not able to show some tangible results, and data around the topic seems difficult to find or to interpret. Clearly, proof of change and distrust towards the unknown are important topics that seem to be influenced by age. The older a person is, the less keen he is to modify his lifestyle without knowing the result.

Finally, it has been seen that a person seems to be more engaged in the energy transition if he is informed and passionate about the environmental situation.

To conclude, all the topics surrounding sustainability and the energy transition seem to be still too unknown and not properly defined. People have a lot of doubts and uncertainties, and a general feeling of distrust is a common factor throughout the whole topic.

Nonetheless, improvement is still possible, as people do believe the transition can have positive effects and reach the desired results. What is needed is probably the spread of more awareness, clearer data and more understandable results and guidelines.

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Annexes

Annex A: Survey

Energy transition

For my Master's thesis I am collecting some data on consumer's opinions about the energy transition and other sustainability topics, with particular focus on the oil and gas sector. Please, do not worry if you don't know exactly what this is: the questions are general and focused on your personal feelings and experience. There is no right or wrong answer.

Participation is on a **voluntary basis** and you can stop the survey whenever you want. If you, at any point, decide not to continue, I kindly ask you to close the page rather than answering casually. The data collected will be **completely anonymous** and the general personal information asked has the only purpose of analysing the sample in its entirety and will, in no way, be linked to a single person. Privacy is respected and guaranteed in all phases of the project.

Time required: ca. 10min

Are you in favour of sharing you anonymous opinions on this topic?

- a. Yes, I have understood the premises and I want to proceed with the survey
- b. No, I want to conclude here (end of the interview)

Part I: General personal information

Remember: this information will remain anonymous and will not be linked to a specific person. It has the only purpose of analysing the entire sample

1. Where are you located?
 - a. Italy
 - b. Austria
 - c. France
 - d. Germany
 - e. Spain
 - f. Other EU country
 - g. Non-EU country

h. Other_____

2. Sex

- a. Male
- b. Female
- c. Non – binary
- d. Other_____

3. Age (in numbers)_____

4. Level of education

- a. Pre – high school degree
- b. High school degree
- c. Bachelor’s degree
- d. Master’s degree
- e. PhD or other post-master’s degree
- f. Other_____

5. Occupation

- a. Student
- b. Self employed
- c. Manager
- d. Employee
- e. Unemployed
- f. Retired
- g. Other_____

6. Average yearly income

- a. < 30.000 euros
- b. 30.000 – 70.000 euros
- c. 70.000 – 100.000 euros
- d. > 100.000 euros

Part II: Sustainability topics

7. As a consumer, are you interested in topics related to sustainability?
 - a. Yes and I try to be as informed as possible when making my decisions
 - b. Yes but it does not influence my decisions
 - c. No, I don't care
 - d. I don't know

8. How do you mainly learn about these topics?
 - a. I read articles/Listen to the news
 - b. I do some research on the companies I'm buying from
 - c. I talk to people that work in the field or that are more informed than me
 - d. I don't do any type of research

9. Do you think of yourself as a sustainable consumer?
 - a. Yes, I only buy sustainable products
 - b. More or less: I would like to but I don't always make the most sustainable choice due to other reasons
 - c. Not really, I am concerned about the environment but it does not influence my buying decisions
 - d. No, I buy what's best for me without considering where it comes from or how it was made

10. How important is it for you the provision of reliable and exhaustive of information/data regarding the sustainability practices followed by the companies?
 - a. Very important, I need transparency to make my decisions
 - b. Important but it does not influence my decisions
 - c. I do not look at any type of data when choosing my products or services
 - d. Not important

Part III: Energy transition

11. Do you know what the energy transition is?
 - a. Yes

- b. No

12. How would you define the term energy transition?

- a. A company strategic issue: the companies in the energy sector are shifting from fossil – based systems of energy production and consumption, to renewable energy sources
- b. A social issue: the change in consumer’s preferences followed by a change in the primary form of energy consumption of a given society
- c. An environmental issue: the shift towards new energy sources to create a more sustainable economy, to ease climate change and other environmental problems
- d. A political issue: a change towards renewable energy resources due to obligations coming from governments and other external regulations
- e. Other_____

13. What do you think is the main reason driving a company to start an energy transition?

- a. Ease the environmental problems and the climate change
- b. Comply with government regulations and requirements
- c. Offer better products in terms of quality and long-term performance
- d. Improve the company’s image and reputation for consumers and external parties
- e. Other_____

14. As a consumer, what do you think is the main advantage of an energy transition?

- a. Positive impact on the environment
- b. Better-quality products and services
- c. Development of new technologies and practices
- d. Job creation
- e. Reduction in energy bills
- f. Other_____

15. As a consumer, what do you think is the main disadvantage of an energy transition?
- More expensive and lower performing products
 - Uneasy way to prove the reliability of information and lack of data
 - Unrealistic expectations as energy from fossil fuels is too important in today's world
 - Long-time frame to see the results
 - Distrust towards new unknown forms of energy against trusted old ones
 - Other _____
16. If a company in the energy sector has started an energy transition
- I am more keen to buy its products
 - I am less keen to buy its products
 - It doesn't affect me
 - I don't know
17. How important do you think is the role of policies by external agents (e.g. governments) for the energy transition?
- Very important, it helps entities follow rules
 - Important but often put companies in difficult positions and higher costs
 - The company should focus on the energy transition but external rules and policies are too harmful and should be avoided
 - Not important

Part IV: Oil and gas sector

18. The oil and gas industry is one of the least sustainable industries
- Totally agree
 - Partially agree
 - Partially disagree
 - Totally disagree
19. The oil and gas industry is dependent on fossil – based products and cannot shift to sustainable resources

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

20. The oil and gas industry will start the energy transition and will succeed

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

21. The oil and gas industry will disappear after the energy transition

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

Part V: Thoughts and beliefs on the transition

22. I would support the shift of a company towards more sustainable production practices even if it means paying a higher price for the final product

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

23. I would support a company in the transition if it was easier to have reliable and clear data about it

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

24. I would be more interested in the energy transition if I could see some short – term tangible results

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

25. I will be reluctant in conforming to new sustainable-energy solutions and technologies as I don't know how efficient they might be

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

26. I want to support the companies in the energy transition as I believe the current climate crisis is a big problem and this could help

- a. Totally agree
- b. Partially agree
- c. Partially disagree
- d. Totally disagree

Annex B: RStudio Ordinal Logistic Regression code (model on Q1)

#Import database from the excel file

```
library(readxl)
```

```
mydata <- read_excel("~/Desktop/Energy_Transition_Q1.xlsx")
```

#Look at the structure of the data

```
str(mydata)
```

#Convert the variables into factors

```
mydata$Geography <- as.factor(mydata$Geography)
```

```
mydata$Gender <- as.factor(mydata$Gender)
```

```
mydata$Age <- as.factor(mydata$Age)
```

```
mydata$Education <- as.factor(mydata$Education)
```

```
mydata$Occupation <- as.factor(mydata$Occupation)
```

```
mydata$Income <- as.factor(mydata$Income)
```

```
mydata$Interest <- as.factor(mydata$Interest)
```

```
mydata$Knowledge <- as.factor(mydata$Knowledge)
```

```
mydata$Q1 <- as.factor(mydata$Q1)
```

#Check the conversion worked and look at the new structure of the data

```
str(mydata)
```

#Implement the Multinomial Logistic Regression

```
library(nnet)
```

#Indicate which is the reference value out of the four possibilities <- for Q1, Totally agree

```
mydata$Q1 <- relevel(mydata$Q1, ref="Totally agree")
```

#Indicate the reference values for the independent variables as well

```
mydata$Geography <- relevel(mydata$Geography, ref=1)
```

```
mydata$Gender <- relevel(mydata$Gender, ref=1)
```

```
mydata$Age <- relevel(mydata$Age, ref=1)
```

```
mydata$Education <- relevel(mydata$Education, ref=3)
```

```
mydata$Occupation <- relevel(mydata$Occupation, ref=1)
```

```

mydata$Income <- relevel(mydata$Income, ref=1)
mydata$Interest <- relevel(mydata$Interest, ref=1)
mydata$Knowledge <- relevel(mydata$Knowledge, ref=1)
#Create the multinomial model where Q1 is a function of all the other variables
mymodel <- multinom(Q1~., data = mydata)

#Look at the information about the regression
summary(mymodel)

#Find the variables that are statistically significant
#Implement the Two-tail z-test and find the p-values
z <- summary(mymodel)$coefficients/summary(mymodel)$standard.errors
z
p <- (1- pnorm(abs(z), 0, 1)) * 2
p
#To be significant, p values should be <0.1 (90% confidentiality) -> the others can be
excluded

```

Annex C: RStudio Multinomial Logistic Regression code (model on Q1)

#Import database from the excel file

```
library(readxl)
```

```
mydata <- read_excel("~/Desktop/Energy_Transition_Q1.xlsx")
```

#Look at the structure of the data

```
str(mydata)
```

#Convert the variables into factors

```
mydata$Geography <- as.factor(mydata$Geography)
```

```
mydata$Gender <- as.factor(mydata$Gender)
```

```
mydata$Age <- as.factor(mydata$Age)
```

```
mydata$Education <- as.factor(mydata$Education)
```

```
mydata$Occupation <- as.factor(mydata$Occupation)
```

```
mydata$Income <- as.factor(mydata$Income)
```

```
mydata$Interest <- as.factor(mydata$Interest)
```

```
mydata$Knowledge <- as.factor(mydata$Knowledge)
```

```
mydata$Q1 <- as.factor(mydata$Q1)
```

#Check the conversion worked and look at the new structure of the data

```
str(mydata)
```

#Implement the Multinomial Logistic Regression

```
library(nnet)
```

#Indicate which is the reference value out of the four possibilities <- for Q1, Totally agree

```
mydata$Q1 <- relevel(mydata$Q1, ref="Totally agree")
```

#Indicate the reference values for the independent variables as well

```
mydata$Geography <- relevel(mydata$Geography, ref=1)
```

```
mydata$Gender <- relevel(mydata$Gender, ref=1)
```

```
mydata$Age <- relevel(mydata$Age, ref=1)
```

```
mydata$Education <- relevel(mydata$Education, ref=3)
```

```
mydata$Occupation <- relevel(mydata$Occupation, ref=1)
```

```

mydata$Income <- relevel(mydata$Income, ref=1)
mydata$Interest <- relevel(mydata$Interest, ref=1)
mydata$Knowledge <- relevel(mydata$Knowledge, ref=1)
#Create the multinomial model where Q1 is a function of all the other variables
mymodel <- multinom(Q1~., data = mydata)

#Look at the information about the regression
summary(mymodel)

#Find the variables that are statistically significant
#Implement the Two-tail z-test and find the p-values
z <- summary(mymodel)$coefficients/summary(mymodel)$standard.errors
z
p <- (1- pnorm(abs(z), 0, 1)) * 2
p
#To be significant, p values should be <0.1 (90% confidentiality) -> the others can be
excluded

```

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