2024/392292 - *Green SMEs*

Hydrogen in the SME sector – production

Feasibility study

November 2024

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This document is developed in the framework of the *Green SMEs* project (2024/392292), by experts from the partnership of:

- ✓ National Council of Small and Medium-Sized Private Enterprises in Romania
- ✓ SMB Norge
- ✓ Patronage of Small and Medium Enterprises Bucharest - Ilfov

Co-funded by a grant from Iceland, Liechtenstein and Norway, through the EEA Grants Romania 2014-2021, within the framework of the Bilateral Cooperation Program for Green Transition Romania.

Supported by a grant from Iceland, Liechtenstein and Norway through the EEA Grants Romania 2014-2021, in the frame of the Program for Bilateral Cooperation in the Green Transition Romania.

FEASIBILITY STUDY[1)]

(A) WRITTEN PIECES

1. General information on the investment objective

1.1. Name of the investment objective

"Hydrogen in the SME manufacturing sector"

1.2. Principal Authorizing Officer/investor

1.3. Authorizing Officer (secondary/tertiary)

1.4. Beneficiary of the investment*: name of the applicant and its identification data, CAEN code, registered office, working points, etc.*

1.5. Feasibility Study Developer

PIMM Bucharest - Ilfov

2. Existing situation and need for the investment objective/project

In this section the necessity and appropriateness of the investment will be substantiated

2.1. The conclusions of the pre-feasibility study (if previously elaborated) on the current situation, the need and opportunity to promote the investment objective and the technical-economic scenarios/options identified and proposed for analysis - *not applicable*

2.2. Background: policies, strategies, legislation, relevant agreements, institutional and financial structures

Renewable hydrogen is seen as an important vector for reducing greenhouse gas emissions, playing a critical role in the energy transition to "net zero emissions". As part of the decarbonization process, the development of a robust system of renewable energy sources, hydrogen can be a substitute for fossil fuels currently used by the SME sector, contributing to reducing emissions in sectors vital to the Romanian economy such as industry and transport, but also in the energy and heating sectors. In order to achieve the 2030 decarbonization targets and obtain economic benefits from the use of hydrogen in key sectors of the economy, immediate measures are needed throughout the hydrogen value chain, in close connection with securing economic opportunities for areas with intensive consumption potential (e.g. steel, fertilizer, cement industries or as an energy storage option).

The overall objective of the study is to address the main challenges of the small and medium-sized private enterprise sector in Romania in terms of decarbonization and air pollution, respectively ensuring the green transition by promoting renewable electricity generation, energy efficiency and future technologies.

The project will achieve the following objectives:

1. Achieving the European Union targets for renewable energy production set out in Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources;
2. Increased electricity production from renewable sources contributing to the objectives of the European Green Pact as a strategy for Europe's sustainable growth and combating climate change in line with the Union's commitments to implement the Paris Agreement and the UN Sustainable Development Goals;
3. Increasing the share of renewable energy in total primary energy consumption, as a result of investments to increase the installed capacity of solar renewable electricity generation;
4. Achieving the objective of climate neutrality, as set out in Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing a framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Act'), relating to ensuring, by 2050 at the latest, a Union-wide balance between emissions and removals of greenhouse gases that are regulated in Union law, so as to achieve zero net emissions by that date;
5. Increasing the share of renewable energy in total primary energy consumption as a result of investments to increase the installed capacity of green hydrogen production.

The effective decarbonization of the SME sector involves the use of hydrogen as an energy carrier and calls for an updated and user-friendly legal framework, which needs to be smoothly integrated into the current legislation.
Energy and raw materials used for hydrogen production are preferably local. Local production of hydrogen can support intermittent renewable energy management and at the same time could keep the added economic value of the SME sector locally or regionally while avoiding external energy dependency on fossil fuels.

European legislative acts and relevant national plans and strategies:

I. European: Climate neutral Europe (European Hydrogen Strategy)

1. Communication from the Commission (COM(2020) 301 final), A Hydrogen Strategy: Towards a Hydrogen

2. European Green Deal

3. Proposal for a Directive of the European Parliament and of the Council 2021/803 on common rules for the internal markets in renewable gas, natural gas and hydrogen

4. Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (RED II)

5. Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 on the promotion of the use of energy from sources

6. Proposal for a Delegated Regulation concerning the establishment of a Union methodology laying down detailed rules for the production of liquid and gaseous non-biological liquid and gaseous renewable fuels for transport and industry

7. Proposal for a Delegated Regulation establishing a minimum threshold for the reduction of greenhouse gas emissions from recycled carbon fuels and specifying a methodology for assessing the greenhouse gas emission reductions from non-biological liquid and gaseous transportation fuels and recycled carbon fuels

8. Proposal for a Regulation of the European Parliament and of the Council on ensuring a level playing field for sustainable air transport COM(2021) 561 final (ReFuelEU Aviation)

9. Proposal for a Regulation of the European Parliament and of the Council on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC COM(2021) 562 final (FuelEU Maritime Initiative)

10. Communication from the Commission REPowerEU Plan COM(2022) 230 final (REPowerEU)

11. Proposal for a Regulation of the European Parliament and of the Council on the deployment of alternative fuel infrastructure and repealing Directive 2014/94/EU of the European Parliament and of the Council COM(2021) 559 final (AFIR Regulation)

12. European Commission Delegated Regulation (EU) 2022/1214 II.

National legislation:

1. Romania's National Recovery and Resilience Plan (NRRP)
2. National Integrated Plan for Energy and Climate Change 2021-2030 (PNIESC)
3. Government Program 2021-2024
4. National Strategy for Sustainable Development of Romania 2030
5. National strategy on circular economy
6. National strategy on adaptation to climate change for the period 20222030, with a 2050 perspective
7. Draft National Strategy for the development of the nuclear sector in Romania for the period 2021-2030, with a 2050 perspective
8. National nuclear program
9. National Strategy for Research, Innovation and Smart Specialization 2022-2027

At the end of 2020, the European Commission communicated its assessment of the National Plans and the recommendation for Romania is to increase its level of ambition from 30.7% to at least 34%. But this is likely to become even higher as Romania will have to adjust its national plan by 2023 to reflect the new EU target of at least a 55% reduction in greenhouse gas emissions.

Although it may seem daunting, this wave of development has access to more generous financial instruments than ever before. For a start, the EU has set up a range of funds and mechanisms, some dedicated entirely to clean energy development and others that point to the sector as vital for the future. In addition, financial institutions have become reluctant to finance conventional energy sources and have instead turned their attention (and funds) to renewable energy. Investors are also prepared to use their own funds, especially if the state decides to lend a helping hand through support schemes or well-designed market instruments.

For the massive investment needed to reach the targets set, Romania, along with the other member states, receives generous financial support from the EU.

Romania's Energy Strategy 2020-2030, with a 2050 perspective.

Romania's Energy Strategy proposes concrete targets, sets clear directions and defines the benchmarks by which Romania will maintain its position as an energy producer in the region and as an active and important player in managing regional stress situations. The Energy Strategy also provides the basis for Romania's position in relation to the proposals for reforming the European energy market, and an important place is given to analyzing the European context and the policies for creating the Energy Union of which Romania will be a member.

The Energy Strategy has eight fundamental strategic objectives that structure the entire analysis and planning approach for the period 2020-2030 and the time horizon of 2050. The achievement of the objectives implies a balanced approach to the development of the national energy sector, correlated with the amount of investment expenditure. The implementation of the project will contribute to the achievement of Objective 2. Clean energy and energy efficiency.

The vision of Romania's Energy Strategy can lead to increasing the competitiveness of the small and medium enterprises sector in conditions of sustainability, economic growth and accessibility, in the context of the implementation of the new legislative package Clean Energy for All Europeans 2030, with the setting of targets for the reduction of greenhouse gas emissions, renewable energy sources and energy efficiency and with the perspective of Romania's implementation of the European Ecological Pact 2050.

2.3. Analysis of the existing situation and identification of shortcomings

GDP and potential growth

Gross Domestic Product growth remained strong in 2019, close to the previous year's level. Real GDP grew by 3.9% in 2019, reflecting strong consumer spending and a revival in investment. After declining in 2018, gross fixed capital formation contributed positively to growth in 2019, mainly supported by the booming construction sector. Net exports continued to make a negative contribution to growth as weaker external demand slowed export momentum and imports continued to be supported by strong domestic demand.

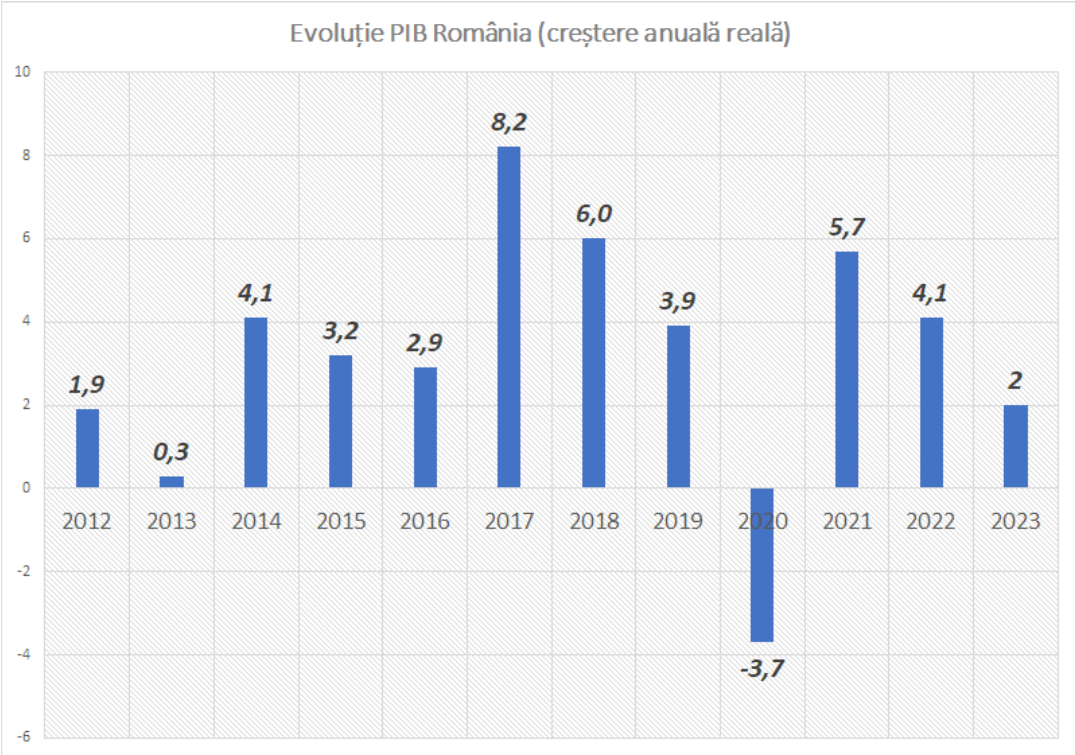
Growth is expected to slow progressively over the medium term. There has been a slowdown in real GDP growth in 2020 and 2021, with consumer spending the main driver of growth. Net exports are expected to continue to act as a drag on growth, but to a lesser extent than in 2019. Last but not least, investment is expected to continue to make a positive contribution to growth, albeit at a lower level in the coming years, supported by the construction sector and accelerated absorption of EU funds.

Industrial production entered a contractionary phase in 2019. Between the end of 2017 and the end of 2018, the growth rate of industrial production fell by almost 10 percentage points and turned negative in the second quarter (Q2) of 2019. Manufacturing productivity fell by 1.6 percent during the first three quarters of 2019. The output of consumer goods has been falling more and more each month since September 2018, while the output of capital goods entered a contraction phase in April 2019. At the end of Q3-2019, more than 70,000 manufacturing jobs were lost compared to the corresponding quarter of 2018. Capacity utilization in manufacturing started to decline in Q4-2018.

Potential growth is largely driven by total factor productivity and risks being affected by demographic trends. Potential GDP growth fell slightly in 2019 and will continue to fall thereafter. Total factor productivity is projected to slow but will remain the main contributor to growth. The contribution of capital accumulation to growth is projected to remain broadly stable. On the other hand, the labor force, which already makes an already modest contribution to growth, is expected to continue to decline, mainly due to the steady decline in the working-age population.

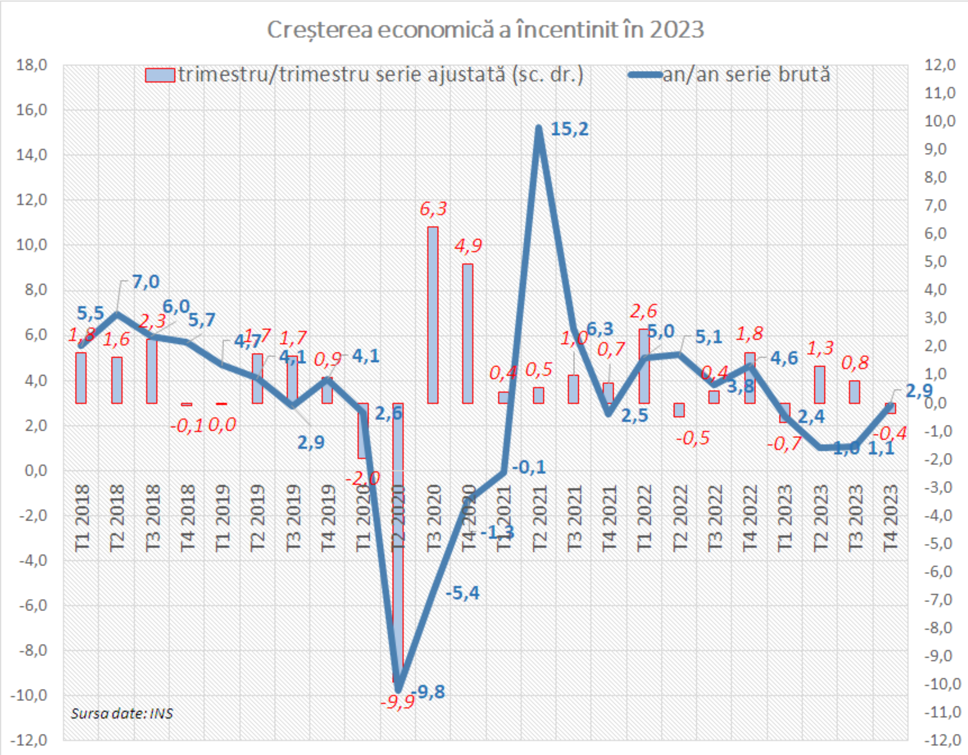
Romania's Gross Domestic Product (GDP), i.e. the added value produced in the country, reached 1.6 trillion lei in 2023, according to the latest statistics published by the National Institute of Statistics (NIS), the highest level in history, and the GDP has increased 2.5 times in the last 10 years alone, from 640 billion lei in 2013 to over 1.6 trillion lei in 2023.

Romania's economy recorded a real growth of 2.1% in 2023, i.e. the advance in Gross Domestic Product minus inflation, which inflates GDP. In euro terms, Romania's GDP reached 320 bn in 2023 and is forecast to pass 350 bn in 2024.



Regional disparities

GDP per capita continues to approach the EU average, but regional disparities persist. Income disparities are among the highest in the EU, mainly due to the wide gap between the Bucharest-Ilfov region and the rest of the country. In five out of Romania's eight development regions (NUTS 2 regions), GDP per capita grew faster than the EU average, while the three regions with the highest levels of poverty experienced a fall in GDP per capita. In the capital region, GDP per capita is 144% of the EU average and has grown fastest in the last six years. With a GDP equal to 67% of the EU average, the West region ranks second among Romanian regions in terms of GDP per capita. In Romania's other regions, GDP per capita varies between 39% and 60% of the EU average.



Demography

Romania's population has declined in recent decades and is expected to decline further. The population has decreased by 3.8 million since 1990 and is expected to reach 15 million by 2070 from the current level of 19.4 million, as a result of demographic changes, including large emigration. As a result, the old-age dependency ratio, i.e. the ratio of people aged 65 and over to the working-age population (15-64 years), is projected to double from 26.3% in 2016 to 52.8% in 2070. This means that, for every person aged over 65, the number of people of working age would fall from almost four to just two. Population ageing has a negative impact on the adequacy of pensions and future health care expenditure, as well as on the long-term sustainability of public finances.

Policy, institutional and regulatory factors

In the context of policy efforts to support investments in renewable energy production and due to structural shifts in the economy towards less energy-intensive production and service sectors, Romania is on the right track to meet its 2020 energy-climate targets. However, the European Commission warns that, in the context of current policies, the renewable energy, emission reduction and energy efficiency targets for 2030 are challenging, even in the context of ambitious policies and programs, as set out in the unrevised version of the National Integrated Energy and Climate Change Plan, which requires investments in the energy sector of EUR 22 billion in the period 2021-2030.

At the end of 2020, the European Commission communicated its assessment of the National Plans and the recommendation for Romania is to increase its level of ambition from 30.7% to at least

34%. But this is likely to become even higher as Romania will have to adjust its national plan by 2023 to reflect the new EU target of at least a 55% reduction in greenhouse gas emissions.

Law 220/2008 is the starting point or the birth of a legislative framework for RES in Romania. The law creates the necessary context to encourage investors to switch to RES, including by introducing a support scheme through green certificates and priority take-up. The support scheme applies to SRE projects started before December 31, 2016. Producers benefiting from this support scheme can continue to sell their certificates gradually until 2031.

Although it may seem daunting, this wave of development gives the SME sector access to more generous financial instruments than ever before. For a start, the EU has set up a range of funds and mechanisms, some dedicated entirely to clean energy development and others that point to the sector as vital for the future. In addition, financial institutions have become reluctant to finance conventional energy sources and have instead turned their attention (and funds) to renewable energy. Investors are also prepared to use their own funds, especially if the state decides to lend a helping hand through support schemes or well-designed market instruments.

For the investment needed to reach the targets set, Romania's SME sector, along with the other Member States, benefits from generous EU financial support.

The vision of Romania's Energy Strategy refers to the growth of the energy sector in conditions of sustainability, economic growth and accessibility, in the context of the implementation of the new legislative package Clean Energy for All Europeans 2030, with the setting of targets for the reduction of greenhouse gas emissions, renewable energy sources and energy efficiency and with the perspective of Romania's implementation of the European Ecological Pact 2050.

2.4. Analysis of the demand for goods and services, including medium- and long-term forecasts of demand trends, in order to justify the need for the investment objective

The necessity and timeliness of the project will be emphasized
Supply/supply market, competition and market strategy that will be applied for the valorization of the products/services obtained through the implementation of the project

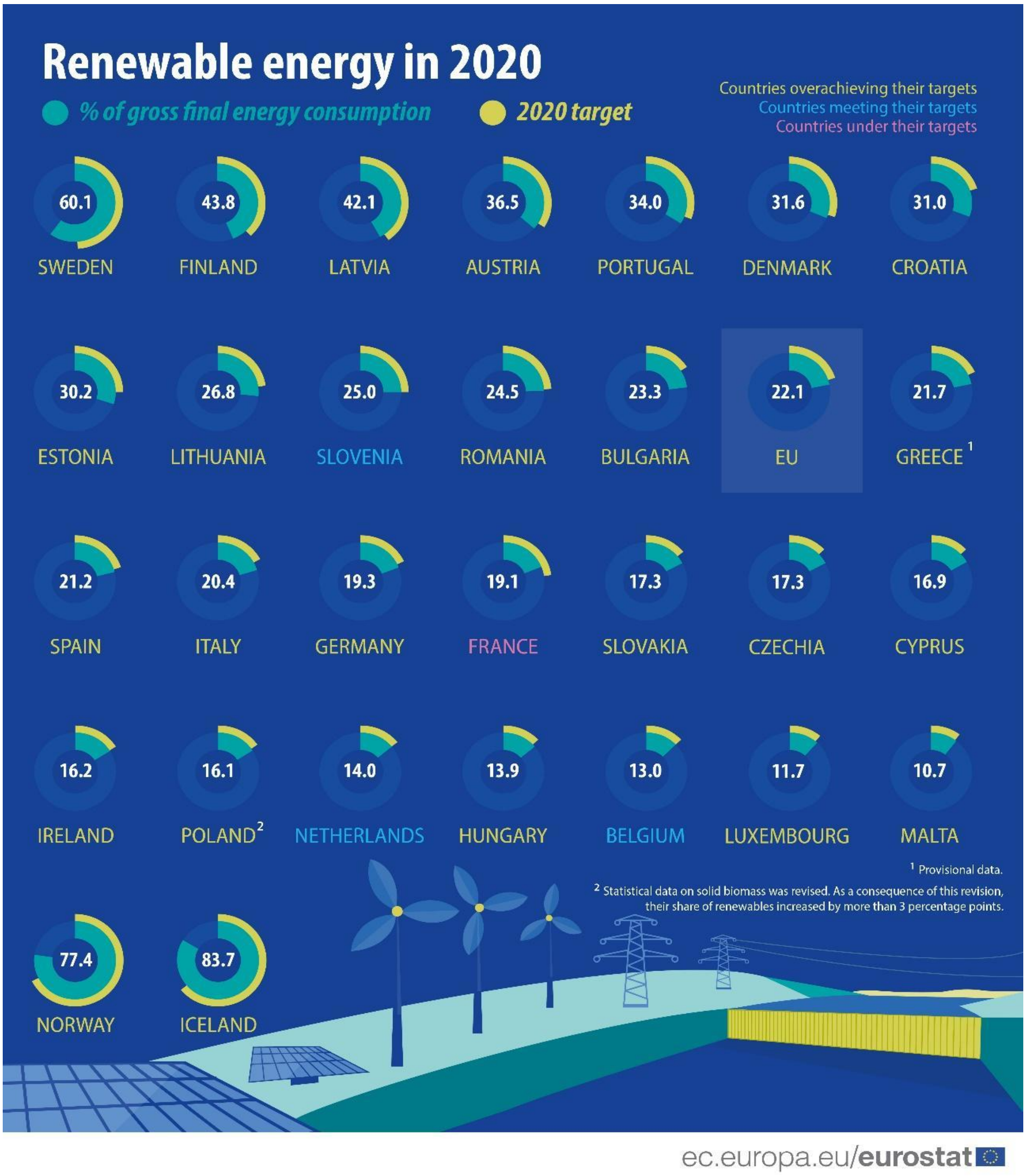
The greenhouse gas neutrality of the SME sector has been defined as a target for 2050 and for the European Union, a goal stipulated in the European Green Deal. It is a legal commitment, a set of initiatives aimed at easing Europe's transition to a clean and circular economy by using resources efficiently, restoring biodiversity and reducing pollution in all its forms.

By 2030, the target for greenhouse gas reductions is at least 50% and towards 60% compared to 1990 levels. One of the main ways in which the European Commission aims to achieve climate neutrality is by decarbonizing the energy sector.

Carbon trading or carbon offsetting and reduction projects are short-term solutions to a pressing problem. 75% of the EU's greenhouse gas emissions come from energy production and use in economic sectors. A number of European funding mechanisms have been put in place to decarbonize the energy sector and reach the targets set under the agreement. Of these, the main beneficiaries of the Just Transition Facility are Poland, Germany and Romania, given their high dependence on fossil fuels for energy consumption. Romania will be able to access up to €4.4 billion as part of this mechanism, which promises to support the transition to low-carbon energy and also to improve energy infrastructure and create new jobs in the green economy.

Renewables accounted for 13.0% of the EU-28 gross inland energy consumption in 2015. The share of renewables in gross inland consumption was relatively high in Denmark (28.4%), Austria (29.0%) and Finland (31.6%) and exceeded one third of inland consumption in Lithuania (35.1%) and Sweden (42.2%), as well as in Albania (34.3%), Norway (44.7%) and Iceland (84.9%).

In 2020, renewable energy accounted for 22.1% of the energy consumed in the EU, about 2 percentage points above the 20% target set for 2020.



Source: Eurostat website

Among the EU Member States, the highest share of renewables in gross final energy consumption in 2015 was recorded in Sweden (53.9%), while Finland, Lithuania, Austria and Denmark each reported that more than 30.0% of their final energy consumption was derived from renewables. Compared with the latest available data for 2015, the targets for the Netherlands, France, Ireland, the United Kingdom and Luxembourg require each of these Member States to increase their share of renewables in gross final energy consumption by at least 6.0 percentage points. In contrast, nine of the Member States have already exceeded their 2020 target; these targets have been far exceeded in particular in Croatia, Sweden and Estonia.

The price and reliability of energy supply, in particular electricity, are basic elements in a country's energy supply strategy. Electricity prices are of particular importance for international market competitiveness as electricity usually accounts for a significant proportion of total energy costs for industrial and service-providing enterprises. Unlike the price of fossil fuels, which are usually traded on world markets at relatively uniform prices, electricity prices vary widely across Member States. The price of primary fuels and, more recently, the cost of carbon dioxide (CO_2) emission allowances influence the price of electricity to some extent.

The Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Tackling the challenge of rising energy prices: A toolbox for action and support; COM2021(0660) final highlights the observed increase in wholesale energy prices. This is expected to be reflected in final consumer prices in official statistics for this reference period. The evolution of energy prices in the second semester of 2021 will be available in European official statistics in April 2022.

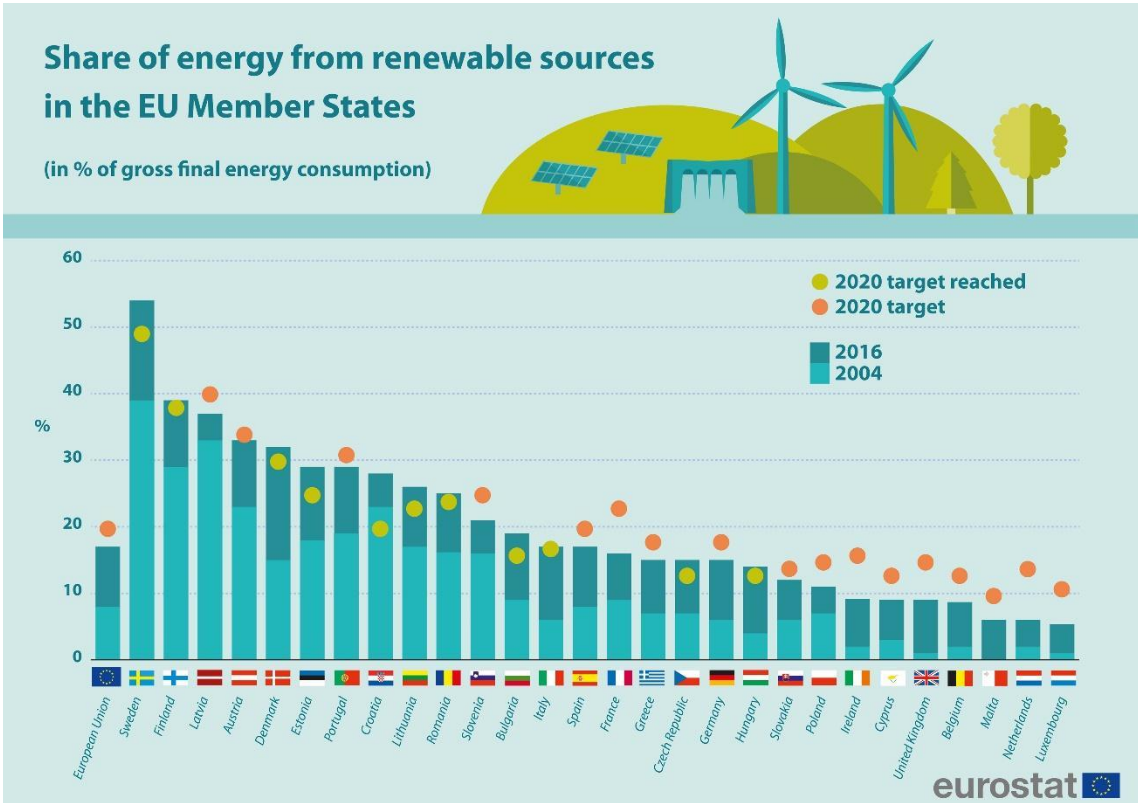
The EU has been working to liberalize the electricity and gas market since the second half of the 1990s. Directives adopted in 2003 established common rules for the internal electricity and gas markets. To date, there are still significant barriers to entry in many electricity and gas markets, as can be seen from the number of markets still dominated by (quasi) monopoly suppliers.

Renewable energy in the EU has grown strongly in recent years. In particular, the share of renewable energy in gross final energy consumption has almost doubled in recent years, from around 8.5% in 2004 to 17.0% in 2016.

This positive development has been driven by the legally binding targets for increasing the share of renewable energy set by Directive 2009/28/EC on the promotion of the use of energy from renewable sources. While the EU as a whole is on track to meet its 2020 targets, some Member States will need to make additional efforts to meet their obligations in relation to the two main targets: the overall share of renewable energy in gross final consumption of energy (see graph below) and the specific share of renewable energy in transport.

In 2016, primary production of renewable energy in the EU-28 was 211 million tons of oil equivalent (toe). Overall, the amount of renewable energy produced in the EU-28 increased by 66.6% between 2006 and 2016, equivalent to an average increase of 5.3% per year.

Among renewable energy sources, wood and other solid biofuels as well as renewable waste were the most important sources in the EU-28, accounting for 49.4% of primary renewable energy production in 2016. Hydropower was the second largest contributor to the renewable energy mix (14.3% of the total), followed by wind power (12.4%). Although the corresponding production levels remained relatively low, there was a particularly rapid expansion in solar and wind power production, with the latter accounting for a 6.3% share of EU-28 renewable energy produced in 2016, while geothermal energy accounted for 3.2% of the total.



Source: Eurostat website

At the national level - Romania has suffered a decline in the attractiveness of renewable energy investment in recent years, partly due to a lack of regulation and adequate government support. According to the latest EY Renewable Energy Renewable Energy Country Attractiveness

Index (RECAI), despite the fact that Romania ranked among the top 40 most attractive countries for renewable energy in 2015 (34th place), in 2020, our country fell below this top, being overtaken by European countries such as Poland, Greece and Austria.

However, in the context of the introduction of the European Green Pact, several multinational energy companies have caught the wave of change and implemented the sustainability agenda in their business strategy. At the same time, they have announced their intention to invest in local clean energy projects.

As the exploitation potential of renewable energy sources was being used below optimal capacity in the Community and it was necessary to accelerate the achievement of the Kyoto Protocol targets, the first Directive regulating electricity from renewable energy sources (Directive number 2001/77/EC, also referred to as the "RES Directive") was issued in the early 2000s.

This normative act set an indicative target of 12% of gross national consumption to come from renewable energy, and the electricity component of this target was set at 22.1% of total EU electricity consumption by 2010, the share to be produced from renewable energy sources.

In the NREAP, Romania has committed itself to a target of 24% of its final energy consumption to be produced from renewable energy sources, this target being composed of three sectoral objectives:

- Share of energy used for heating and cooling from renewable sources
- Share of electricity from renewable energy sources
- Share of renewable energy in transport

Moreover, a gap contract scheme is currently being evaluated by the Ministry of Energy, with financial support from the EBRD, to support investors interested in developing clean energy projects in Romania.

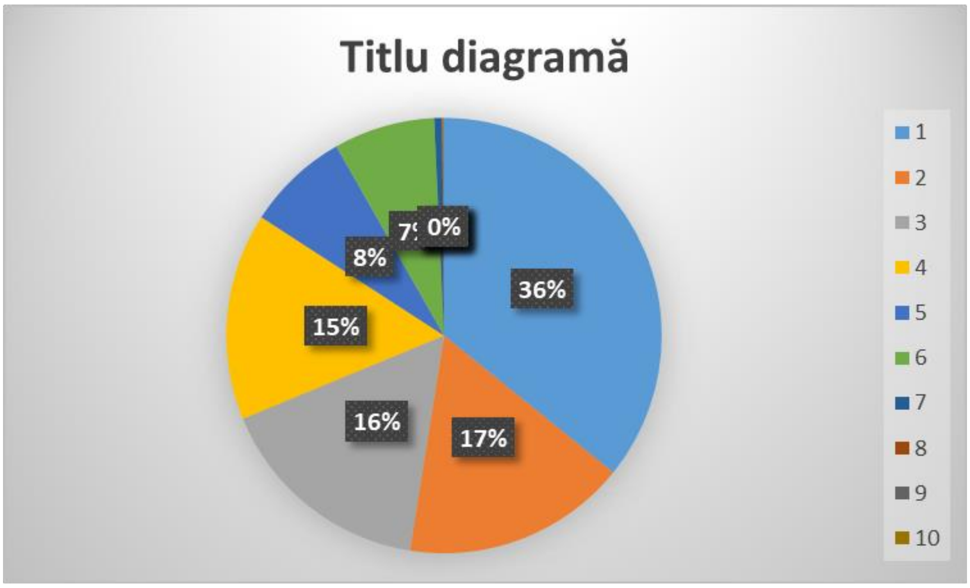
Romania reached its 2020 target of 24% of total energy consumption from renewable sources. For 2030, the new target set by the Romanian government is 30.7%, achievable by adding 7GW in renewable capacity.

Production type	Value /MW

Hydro	6644.43
Carbune	3092.2
Eolian	3014.91
Hydrocarbons	2853.73
Nuclear	1413
Solar	1393.14
Biomass	106.896
Biogas	16.967
Waste	6.03
Waste heat	4.1
Geothermal	0.05
Total:	**18.545.453**

In terms of energy consumption, according to Eurostat data, in 2019, just over 24% of energy consumption came from renewable energy sources, putting Romania in 10th place in the EU and above the EU average.

Romania's greenhouse gas emissions have fallen by more than 50% from 1990 levels due to a significant reduction in energy demand and industrial activity, increased energy efficiency and gradual compliance with more restrictive environmental standards. Today, energy is still the main source of emissions, accounting for 2/3 of national greenhouse gas emissions, followed by agriculture and industry.



The price increase in 2021 was totally unprecedented. Energy import prices, although quite volatile, have not changed by more than about 30% per year in the past, while between December 2020 and December 2021 energy imports cost more than double the previous year.

Russia's military aggression against Ukraine, which began on February 24, 2022, has further disrupted energy markets, increasing pressure on prices, especially for gas and oil, and raising concerns about the security of energy supply in the EU.

Increasing the share of renewable energy in different sectors of the economy is therefore a key element in achieving the EU's energy and climate targets.

2.5. Objectives expected to be achieved by the investment

The present project aims to justify the justification and necessity of utilizing hydrogen production capacity.

The **overall objective of** the project is to put into operation a green hydrogen production capacity in electrolysis plants will contribute to increase the completivity of the SME sector by utilizing a renewable energy capacity - the capacity of electrolysers for hydrogen production

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3. Identification, proposal and presentation of at least two technical-economic scenarios/options for the realization of the investment objective

For each techno-economic scenario/option the following will be presented:

3.1. Site particularities:

a) description of the site (location - intravilan/extravilan, land area, dimensions on the plan, legal regime - nature of ownership or title deed, easements, right of pre-emption, public utility zone, information/obligations/constraints extracted from the urban planning documents, as appropriate);

During the study we analyzed several projects developed by the SME sector in Romania and selected the following site:

Surface area of the land subject to investment:
- 1000 sq.m (measured: 1000 sq.m); attached, land use category.

Legal regime:

- land located in intravilanul UAT
- the land is not listed as a no-building zone;
- the land is not located in a protected area or in a protected area of a historical monument.

The area where the activity is carried out is a mixed use area, there are no neighborhoods represented by human settlements below the distance limit imposed by the legislation in force.

(b) relationships with neighboring areas, existing access and/or possible access routes;

We have proposed and analyzed a site located in the intravilanul UAT with the following neighborhoods:

- to the North: arable land

- East: arable land

- South: arable land

- West: access land

Project location

(c) proposed orientations to cardinal points and to natural or built points of interest;

The location of the investment is oriented to the east

d) existing pollution sources in the area - not applicable

e) climatic and relief data;

From the meteo-climatic point of view, the area belongs to the temperate climate sector which is continental, summers are very hot and dry, and winters are freezing, marked by strong blizzards, but also by frequent interruptions caused by warm and humid air advections from the South and South-West which cause warming and snow melting intervals. The average annual temperature is 10.5 °C, ranging from 21.7 °C in July to -3 ÷ -4 in January. The frost depth in the area is 0.90 m. The climate is moderate-continental, with an average annual temperature of 10-11 °C; western and southern influences explain the presence of long, warm autumns, mild winters and early springs. This moderate-continental climate has some air temperature differences, typical of large cities, caused by the additional heating of the road network, fuel combustion, radiation from building walls, etc. Winters are generally cold, with heavy snowfalls, often accompanied by blizzards. The lowest average monthly temperature is in January, with an average of -3°C. Summer is very hot, in July the average temperature is 23°C, sometimes reaching 35-40°C.

f) the existence of:

- on-site utilities that would require relocation/protection, to the extent that they can be identified;

No utilities requiring relocation/protection have been identified on site.

- possible interference with historical/architectural monuments or archaeological sites on the site or in the immediate vicinity; existence of specific conditions in case of protected or protected areas - *if applicable*;

No historical/architectural monuments or archaeological sites have been identified on the site or in the immediate surrounding area at the time of the study. In case they are identified during the endorsement procedure, the endorsement conditions shall be respected.

- land belonging to institutions forming part of the system of defense, public order and national security - *if applicable*;

No land belonging to institutions that are part of the system of defense, public order and national security has been identified.

g) geophysical characteristics of the land on the site - extract from the geotechnical study prepared in accordance with the standards in force, including:

(i) seismic zoning data;

According to SR 11100/1-1993, the area under study falls in zone VIII on the MSK seismic intensity scale. According to Romania's seismic risk assessment, the location of the investment is in a high seismic risk zone, where intermediate earthquakes with relatively high impact occur.

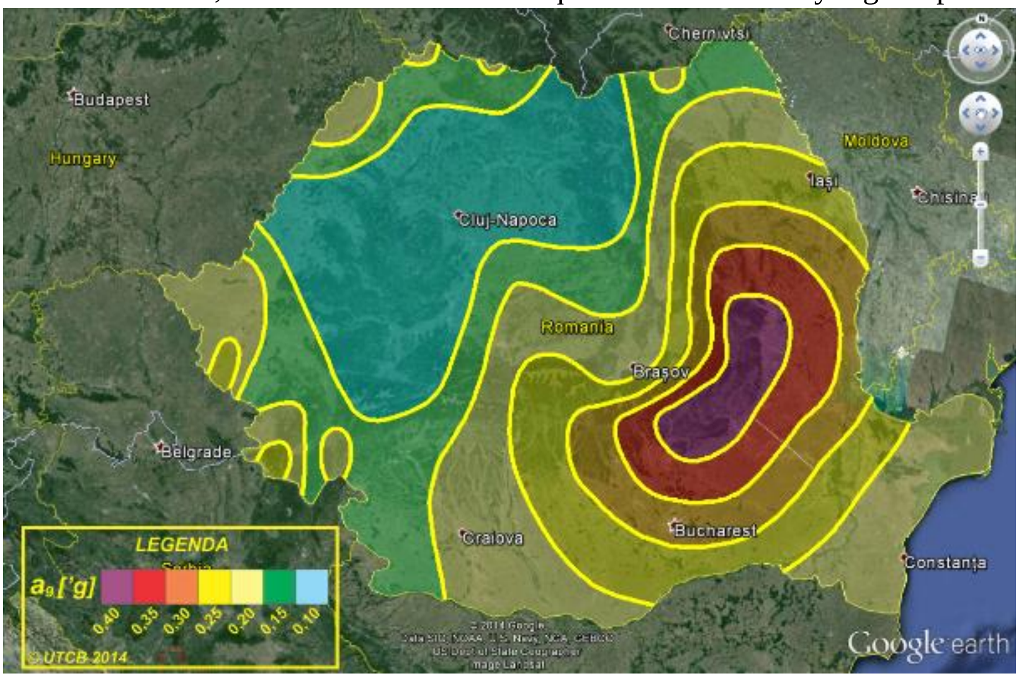


Figure 2 Seismic zonation map (Wikpedia - The Free Encyclopedia, 2020)

Figure 4 Map of earthquake risk zones

(ii) preliminary data on the nature of the bedrock, including conventional pressure and maximum groundwater table;

According to P100 - 1/2013 "Seismic Design Code - Part I: Design Requirements for Buildings" the area where the new installations are located has the following main characteristics:

- Tc (corner period) = 1.5 sec;
- ag (design acceleration of the IMR = 225 years) = 0.25 g.

(iii) general geological data;

Not the case

(iv) geotechnical data obtained from: borehole location plans, complex sheets with the results of laboratory determinations, groundwater analysis, geotechnical report with recommendations for foundation and reinforcement, geotechnical zoning maps, accessible archives, as appropriate;

The following lithologic sequence has been identified:

- 0,00 - 0,40 m - black topsoil;
- 0,40 - 1,00 m - brownish-black clayey powder, plastic, dry, dry consistency;
- 1,00 - 4,00 m - gravel with sand and rare boulder elements.

The hydrostatic groundwater table was not encountered in the boreholes but from previous studies it is over 14.00 m deep.

(v) the risk zones (earthquakes, landslides, floods) in accordance with the technical regulations in force;

According to "Standard CR1-1-4-2012, Design Code. Basics of design and wind action on buildings. Wind action", the reference wind pressure (Kpa), averaged over 10 min at 10 m (50 years mean recurrence interval), for the analyzed location is equal to 0.55 KPa.

According to Guideline CR1 - 1-3-2012, "Design Code. Assessment of snow action on buildings." - The given snow load for the Municipality of Ploiesti is: Sok = 2,4 KN/sq.m (50 years mean recurrence interval).

(vi) the hydrological characteristics established on the basis of existing studies, documentation and bibliographical references.

The site is systematized for rainwater catchment. The analyzed terrain is relatively flat.

3.2. Technical, constructive, functional-architectural and technological description:

- technical characteristics and parameters specific to the investment objective;

- the constructive variant of realization of the investment, justifying its choice;

- specific equipment and facilities for the proposed function.

The containerized system of electrolysers will be located on a 960 m2 dedicated area, benefiting from the existing concrete platform, lighting and fencing system, which will meet all safety and security requirements.

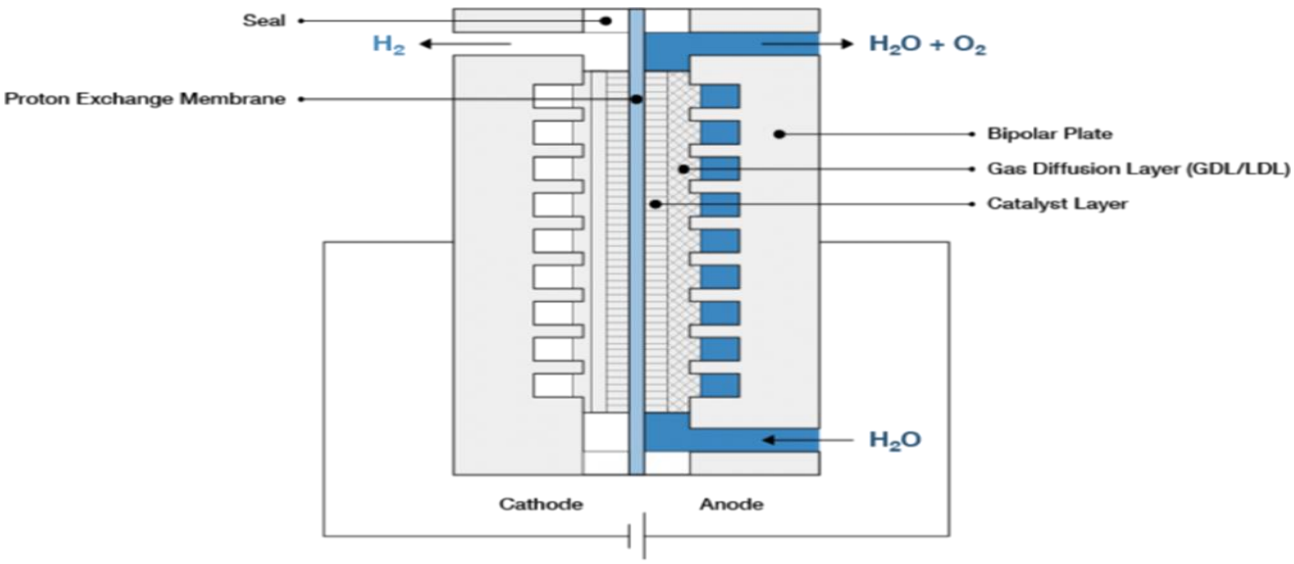
A PEM type electrolysis has been proposed. We consider it to be the most appropriate technology for this project, for reasons of modularity, energy efficiency, safety in operation and other relevant technical characteristics.

Electrolyzers convert electrical energy into chemical energy, producing hydrogen as the energy carrier. In proton exchange membrane (PEM) electrolysis, the electrolyte is a solid polymer immersed in water. Under the action of the direct current applied to this membrane, protons migrate through the membrane, hydrogen is produced at the cathode and oxygen is produced at the anode.

Electrolyzers do not contain liquid electrolyte but a semipermeable solid membrane through which protons can migrate. The electrolyzers operate with only potable water and electricity, are easy to use, require no consumables such as potassium hydroxide (KOH) and are largely maintenance-free. They are also very safe: hydrogen and oxygen are physically separated from each other by the semi-permeable solid membrane.

Advantages of PEM electrolysis:

- Does not use hazardous substances
- Electrolyte is a solid membrane
- Largely maintenance-free
- Compact design
- Produces high purity hydrogen
- The maximum hydrogen outlet pressure is 30 barg
- Dynamic operation with very short response time
- No standby preheating required = > low standby costs.



3.2.1. Description of the technological process

- Water supply.

The drinking water supplied to the system is processed to obtain high purity demineralized water. A wide variety of process technologies are used for this purpose: First, the components that generate the hardness of the water, the calcium and magnesium ions contained in the water are exchanged for sodium ions. This is accomplished using a softener, which is regenerated at regular intervals using a saline solution.

The produced water is then filtered through a bed of activated carbon to retain fine particles, organic matter and chlorine. In the next step, the water is desalinized through a reverse osmosis membrane system which removes up to 99% of the salts contained. A by-product of this stage of the process is a water/salt concentrate containing the separated salts in concentrated form. The yield of this system depends on the concentration of salts contained in the drinking water used but in practice it reaches approx. 75%.

In the final step of the treatment process the remaining salts in the water are separated by an electrochemical deionization system without using chemicals.

- Water electrolysis.

The ultra-pure water produced in water treatment is fed to the PEM electrolysis on the anode side of the cell. Here the water is broken down into its two components O2 and H2. The oxygen remains on the anode side and the hydrogen ions enter the membrane and are available under pressure on the cathode side at the outlet. To ensure optimal surface wetting, the anode side is rinsed with ultrapure water in a continuous circuit.

- Oxygen Separation.

The biphasic water/oxygen mixture exits the PEM electrolysis and is separated in the O2 separator. The oxygen leaves the separator and is discharged to the environment (further use of oxygen is basically possible). The concentration of H2 in the O2 off-gas stream is continuously monitored in order to be able to localize possible faults at an early stage.

- Other processes.

Waste heat generated during electrolysis is absorbed by the circulated water and then released into an air cooler. This provides the PEM electrolyzer with a constant water temperature of 55-60°C. At this point, it is also possible to make additional use of waste heat.

To ensure optimum water quality at all times, the circulation circuit is equipped with an additional safety filter. This filter clears the water of any particles that may be present and also ensures that the ultrapure water has an optimum conductivity at all times.

Hydrogen leaves the PEM electrolyzer saturated with water vapor at a temperature of ~60°C. For drying, the hydrogen flows through a condenser, which cools the gas to ~8°C. The water vapor condensed in this way is separated in the H2 separator and channeled back into the water circuit on the anode side in a controlled manner.

In order to operate the electrolysis stacks under constant conditions, the operating pressure is regulated to the set working pressure (10...30 barg) by a pneumatic pressure regulating valve. The hydrogen then goes through an additional hydrogen purification stage to obtain the required hydrogen quality (99.999%). It consists of two different process steps.

- Hydrogen purification.

In the first stage, the hydrogen is passed through a noble metal catalyst, where the oxygen contained in the hydrogen reacts with the hydrogen to form water. In the second stage of the process, the gas is dried by an adsorption process.

- Delivery.

The hydrogen processed in this way is then introduced into the buffer store at 30 bar. This serves to balance the start and stop processes of the electrolysis unit. The hydrogen is then fed into the natural gas transportation system operated by TRANSGAZ.

3.2.2 System start/stop/safety operations

The on and off time of the whole system is determined by the nitrogen inerting (***additional safety measure***), the cooling water supply and the water circulation system. The initial start-up time is approximately 20 minutes after the system has reached ambient temperature. After a lengthy shutdown, the PEM electrolyzer is purged/inerted with nitrogen (inert gas) for safety reasons before start-up. In parallel with inertization, the cooling water supply and water circulation are activated to shorten the start-up time.

If the system is in standby mode, the start-up time is reduced to approx. 1 minute, because the electrolyzer does not require inertization and the cooling water supply is already available.

The load gradient is 100% per minute at initial start-up and is determined by the inertia of the water temperature. Once the water circuit has reached the target temperature and all control circuitry has stabilized, the stack performance can be varied with a 10% change per second.

The system is switched off in a controlled mode with a 10% reduction per second. Only the cooling circuit and the water circulation continue to run for a few minutes to further drain the water circuit and remove the heat still in the system.

3.2.3. Automation

The hydrogen generation plant **is *fully automated***. This means that the functions of the individual units of the system (pressure control, temperature control, filling level control) are taken over by the automatic control of the whole system. Manual interventions are practically possible but not necessarily necessary for operation.

Operator actions are only required to replenish saline in the water treatment system.

The two electrolysis modules are each equipped with a specific controller. These controllers are connected to the PCS7 automation station provided via bus couplings (Profinet). Thus all process information of the electrolysis plants is available in the DCS.

This ensures fully automated and monitored operation of the entire green hydrogen plant.

3.2.4 The concept of safety and security in operation

In terms of safety, the whole system is divided into zones:

- Design pressure on oxygen/water side 10 bar
- Design pressure of hydrogen (up to buffer) and nitrogen 45 bar
- Cooling circuit design pressure 10 bar
- Auxiliary systems (I-air, etc.) design pressure 10 bar

The parts of the installation in these areas are treated as a separate system from a safety point of view and are protected against overpressure by means of a pressure relief valve and a safety relief valve. In the event of a shutdown, the pressure boosting components (such as pumps, blowers, or heat exchangers) are shut off/disconnected and the inlet flows are shut off. Automatic Shut-off Valves (ESV) prevent fluid from flowing back.

A blow manifold directs the appropriate quantities into the chiller.

In the event of a serious malfunction, the system is equipped with a purge valve (BDV) on the hydrogen side.

The automatic ball valves on the hydrogen side are used in duplicate so that the operational and safety functions are performed by separate actuators.

Individual areas of the plant or individual plant components are equipped with emergency stop switches to trigger a shutdown of the entire plant or components. In addition, emergency stop switches shall be provided at several points in the system to shut down the entire system.

In the event of a power failure, the independent power supply continues to provide power to critical components such as process control, gas detection system to ensure safe shutdown of the plant and safety-relevant components.

Using a Process Safety Integrity Level (SIL) implementation methodology, each electrolysis module has among others:

- Minimum presence of gas in the system
- Minimum pressure detection to avoid air ingress
- PROFISAFE protocol
- Continuous detection of hydrogen in the atmosphere
- Zone II for ventilation
- Safety logic for all parameters
- Uninterruptible Power Supply ("UPS") that ensures a reliable shutdown in the event of a power failure
- Constant monitoring of O2 gas production purity
- Multiple control systems
- Multiple redundancies for safety-critical parameters

Given the specific nature of the investment, two technical-economic scenarios were proposed for this study, defined according to the number and type of electrolyzer. For these scenarios, simulations were carried out on the amount of energy that could be produced in the analyzed location.

Scenario 1 - 2.5 MW electrolyser

Electrolysis modules

To generate the desired quantity of approx. 1000 nmc/h of hydrogen, *the plant consists of two HyLYZER®-500 container modules*, each with a 2.5 MW PEM electrolyzer (installed electrical power).The PEM electrolyzers are modular, designed for easy transportation and installation, with excellent interconnectivity for scalability and unrivaled experience in terms of resilience, low maintenance and maximum operational safety.

Each of the 2 modules consists of the following main components.

a. Container

Electrolyzer containers have the following components:

- Insulated walls and ceilings.
- Floor made of tin.
- Lockable doors in exterior walls.
- Lighting in all sections.
- All equipment fully deployed and installed with piping and cabling, reducing on-site installation/assembly time and costs.
- Heating and forced ventilation (in Zone 2: ATEX Directive 2014/34/EU)
- Safety seal on container roof
- Emergency lights or emergency lights for at least 30 minutes in the event of a power cut
- Outdoor lighting system
- Lights outside the container at the entrance to the control/utility room and process room
- Exhaust lines: Two stainless steel tubes with rain caps for safe venting of H_2 and O_2.
- Heaters to protect equipment from sub-zero temperatures.

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b. Electrolysis module

The central component of the hydrogen generation part of the process is the PEM (Polymer Electrolyte Membrane Membrane Stack) electrolysis stack. The cell stack consists of electrolyte cells, each containing a MEA 'membrane electrode assembly', two GDL 'gas diffusion layers' and a bipolar plate.

H_2 and $O_2$are generated when process/cooling water is fed into the equipment and charged with electricity. Further in the process the gases are directed to the dryer, where the gases are cooled and the water is condensed.

The unit consists mainly of:

- stainless steel frame
- 2x PEM 1500E holds
- Circulation pump for demineralized water
- Injection pump for demineralized water
- hydrogen gas separator
- oxygen gas separator
- Gas cooler for hydrogen "dehumidifier" - coalescing filter
- Heat exchanger for drinking water and gas cooling
- Atmospheric hydrogen leak detector (HTA)
- Oxygen content in the hydrogen produced (HTO)
- instrumentation, sensors, etc.
- closure fittings
- terminal boxes
- separate exhaust system (H_2 and O_2)

c. Hydrogen purification

The hydrogen purification system is designed to further purify hydrogen to a minimum of 99.999%. This purity is achieved in two stages:

- Deoxo stage: reduction of O2 to H2 by catalytic reaction;
- Drying stage: for moisture reduction in 2 absorption tanks: one in operation and one in standby/regeneration mode.

The unit consists mainly of:

- stainless steel frame
- Deoxo tank with catalyst to remove O2 from H2
- Deoxo tank heating and insulation
- heat exchanger
- coalescing filter
- Drainage system for water drainage
- Two absorption drying vessels filled with molecular sieve
- Electrical heating and insulation of the two absorption dryer tanks
- Connecting pipes to the gas cooling circuit
- Connection lines to the exhaust system (H2 and O2)

- shut-off valves
- Online purity measurement (monitoring ppm O_2 in H_2 and ppm H_2O in H_2)
- automatic discharge of H_2 to the atmosphere if its quality is out of specification.
- Automatic restart (PT-U)

d. <u>Water treatment</u>

Demineralized water is circulated through the cell stack of the PEM 1500E at a high flow rate. A small part of the water is split into H_2 and O_2, while most of it is used to dissipate the heat and gases produced. Fresh demineralized water is continuously supplied to balance the water converted into H_2 and O_2. This pure water is produced in skid drinking water treatment. This drinking water treatment pumps demineralized water into a buffer tank. From there, the treated water is fed into the electrolysis process cycle through the injection pump if necessary. There is continuous monitoring of the water quality in the pressurized electrolysis circuit, resulting in a regulated bypass circulation through the internal water treatment system.

The unit consists mainly of:

- stainless steel frame
- Gas separator H_2 H_2 tank drain

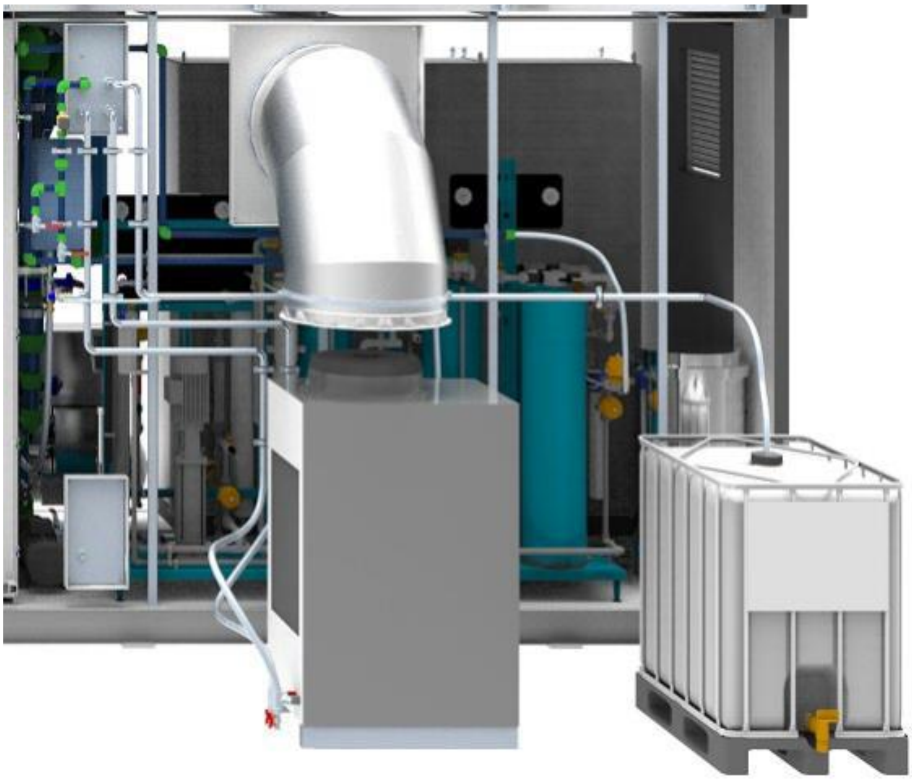
- Buffer tank 1 water circuit
- Buffer tank 2 water circuit
- Level monitoring on each tank
- water circulation pump
- filter
- Continuous water quality monitoring
- valve
- safety valves

e. Utilities

The utility room is a separate room in the container to house other necessary peripherals and the operating system. The gas cooler is installed outside the container. The picture below shows and a catch tank to collect the coolant of the closed cooling circuit in case of a valve failure.

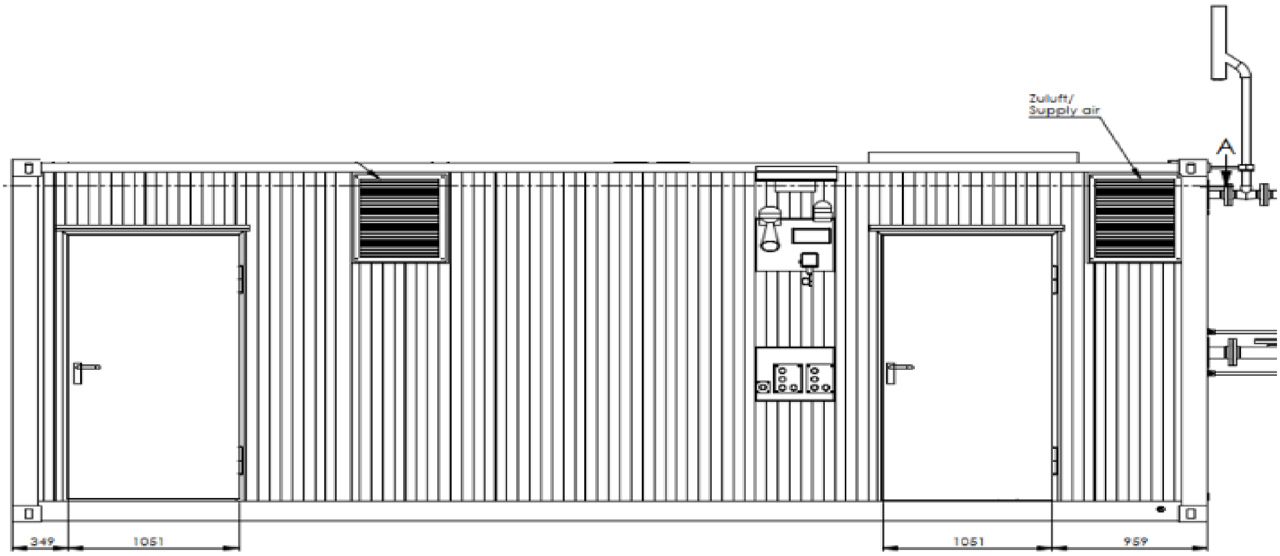
The unit consists mainly of:

- Separate, lockable entrance door
- Thermally insulated walls
- HVAC system
- Water purification system
- Closed-loop cooling water pump
- Cooling water thermostat control
- cooler (outside)
- switch panel



f. Measurement and taxation set point

The Measurement and Control Regulation Point (MCRP) is used to collect the hydrogen produced, reduce or regulate the hydrogen pressure within the operating range of the electrolyzers and to measure the amount of hydrogen produced and delivered to the NTS. The PRMF is containerized.



Scenario 2: Plant with five electrolyzers of 1 MW each

To generate the desired quantity of approx. 1000 nmc/h of hydrogen, the plant consists of 5 container modules, each with a 1 MW PEM electrolyzer (installed electrical power).

PEM system electrolysers are modular, designed for easy transportation and installation, with excellent interconnectivity for scalability and an unrivaled experience in terms of resilience, low maintenance and maximum operational safety.

Otherwise the equipment and features are identical to those in scenario 1.

For both scenarios, equipment has been proposed that meets the minimum requirements set out in the funding guidelines.

3.3. Estimated investment costs:

The estimated costs for realizing the investment objective are presented below in the form of a general estimate.

The estimated costs for realizing the investment objective are presented below in the form of a general estimate.

	Chapter and sub-chapter headings	Value *2)	VAT	

No. crt.		(excluding VAT)		Value with VAT
		lei	lei	lei
1	2	3	4	5
CHAPTER 1 Land acquisition and development costs				
1.1.	Getting the land	1.287.000,00	244.530,00	1.531.530,00
1.2.	Land development	284.865,92	54.124,52	338.990,44
1.3.	Improvements to protect the environment and return the land to its original state	-	-	-
1.4.	Utility relocation/protection expenses	-	-	-
Total chapter 1		1.571.865,92	298.654,52	1.870.520,44
CHAPTER 2 Expenditure on utilities needed for the investment objective				
Total chapter 2		1.475.850,00	280.411,50	1.756.261,50
CHAPTER 3 - Expenditure on design and technical assistance				
3.1.	Studies	52.500,00	9.975,00	62.475,00
3.1.1.	Field studies	7.500,00	1.425,00	8.925,00
3.1.2.	Environmental Impact Report	45.000,00	8.550,00	53.550,00
3.1.3.	Other specific studies	-	-	-
3.2.	Supporting documentation and costs for obtaining permits, agreements and authorizations	238.890,92	45.389,27	284.280,19
3.3.	Technical expertise	10.000,00	1.900,00	11.900,00
3.4.	Energy performance certification and building energy audits	-	-	-
3.5.	Design	359.202,50	68.248,48	427.450,98
	3.5.1. Design theme	5.000,00	950,00	5.950,00
	3.5.2. Pre-feasibility study	-	-	-
	3.5.3. Feasibility study/documentation for the authorization of works and general estimate	49.195,00	9.347,05	58.542,05
	3.5.4. Technical documentation required in order to obtain permits/approvals/authorizations	12.298,00	2.336,62	14.634,62

	3.5.5. Technical verification of the quality of the technical design and of the execution details	22.137,00	4.206,03	26.343,03
	3.5.6. Technical design and execution details	270.572,50	51.408,78	321.981,28
3.6.	Organization of procurement procedures	-	-	-
3.7.	Advice	618.773,00	117.566,87	736.339,87
	3.7.1. Project management for the investment objective	606.475,00	115.230,25	721.705,25
	3.7.2. Financial audit	12.298,00	2.336,62	14.634,62
3.8.	Technical support	193.335,00	36.733,65	230.068,65
	3.8.1. Technical assistance from the designer	110.688,00	21.030,72	131.718,72
	3.8.1.1. during the execution of the works	49.195,00	9.347,05	58.542,05
	3.8.1.2. for the participation of the designer in the phases included in the control program of the execution works, approved by the State Inspectorate for Construction	61.493,00	11.683,67	73.176,67
	3.8.2. Site management	82.647,00	15.702,93	98.349,93
Total chapter 3		1.472.701,42	279.813,27	1.752.514,69
CHAPTER 4 - Expenditure on basic investment				
4.1.	Construction and installation	2.860.652,32	543.523,94	3.404.176,26
4.2.	Assembly of machinery, technological and functional equipment	3.291.965,42	625.473,43	3.917.438,85
4.3.	Machinery, functional technological equipment requiring assembly	39.501.000,00	7.505.190,00	47.006.190,00
4.4.	Machinery, technological and functional equipment not requiring assembly and transportation equipment	45.900,00	8.721,00	54.621,00
4.5.	Facilities	-	-	-
4.6.	Intangible assets	-	-	-
Total chapter 4		45.699.517,74	8.682.908,37	54.382.426,11
CHAPTER 5 Other expenditure				

5.1.	Site organization	272.400,00	51.756,00	324.156,00
	5.1.1. Construction works and installations related to site organization	257.400,00	48.906,00	306.306,00
	5.1.2. Expenses related to site organization	15.000,00	2.850,00	17.850,00
5.2.	Fees, rates, taxes, cost of credit	703.543,35	-	703.543,35
	5.2.1. Fees and interest related to the financing bank's loan	-		-
	5.2.2. SAI quota for quality control of construction works	228.497,59		228.497,59
	5.2.3. SAI rate for state control in spatial planning, town and country planning and for the authorization of construction works	30.763,09		30.763,09
	5.2.4. Quota for the Social House of Builders - CSC	40.853,67		40.853,67
	5.2.5. Fees for agreements, compliant permits and building/abolition authorization	403.429,00		403.429,00
5.3.	Miscellaneous and unexpected expenses	40.729,00	7.738,51	48.467,51
5.4.	Expenditure on information and publicity	5.000,00	950,00	5.950,00
Total chapter 5		1.021.672,35	60.444,51	1.082.116,86
CHAPTER 6 - Expenditure on technological samples and tests				
6.1.	Operational staff training	14.200,00	2.698,00	16.898,00
6.2.	Technological tests and trials	59.400,00	11.286,00	70.686,00
Total chapter 6		73.600,00	13.984,00	87.584,00
GRAND TOTAL		51.315.207,43	9.616.216,18	60.931.423,60
of which: C + M (1.2 + 1.3 +1.4 + 2 + 4.1 + 4.2 + 5.1.1)		8.170.733,66	1.552.439,40	9.723.173,06

The itemized cost of the investment is presented below:

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No cap. General Estimate	Name of chapters and sub-chapters of expenditure	Value (excluding VAT)	VAT	Value (including VAT)
		You	You	You
1	2	3	4	5
Basic investment expenditure				
CHAPTER I Construction and installations				
4.1.1	Earthworks, vertical landscaping and landscaping			
4.1.2	Resistance			
4.1.3	Architecture			
4.1.4	Installations	2.860.652,32	543.523,94	3.404.176,26
4.1.5	Other construction categories			
TOTAL CHAPTER I		**2.860.652,32**	**543.523,94**	**3.404.176,26**
CHAPTER II Assembly				
4.2	Assembly of machinery, technological and functional equipment	3.291.965,42	625.473,43	3.917.438,85
TOTAL CHAPTER II		**3.291.965,42**	**625.473,43**	**3.917.438,85**
CHAPTER III Procurement				
4.3	Machinery, technological and functional equipment requiring assembly	39.501.000,00	7.505.190,00	47.006.190,00
4.4	Machinery, technological and functional equipment not requiring assembly and transportation equipment			
4.5	Endowments	45.900,00	8.721,00	54.621,00
4.6	Intangible assets			
TOTAL CHAPTER III		**39.501.000,00**	**7.505.190,00**	**47.006.190,00**
TOTAL DO		**45.653.617,74**	**8.674.187,37**	**54.327.805,11**

The financial cost of the investment is presented below:

Financial statement - Chapter 3 - Expenditure on design and technical assistance				
No. crt.	**Specification**	**Value *2) (excluding VAT)**	**VAT**	**Value with VAT**
		lei	**lei**	**lei**
1	2	3	4	5
CHAPTER 3 - Expenditure on design and technical assistance				
3.1.	Studies	52.500,00	9.975,00	62.475,00
3.1.1.	Field studies	7.500,00	1.425,00	8.925,00
3.1.2.	Environmental Impact Report	45.000,00	8.550,00	53.550,00
3.1.3.	Other specific studies	-	-	-
3.2.	Supporting documentation and costs for obtaining permits, agreements and authorizations	238.890,92	45.389,27	284.280,19
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	3.5.1. Design theme	5.000,00	950,00	5.950,00
	3.5.2. Pre-feasibility study	-	-	-
	3.5.3. Feasibility study/documentation for the authorization of works and general estimate	49.195,00	9.347,05	58.542,05
	3.5.4. Technical documentation required in order to obtain permits/approvals/authorizations	12.298,00	2.336,62	14.634,62
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	3.5.6. Technical design and execution details	270.572,50	51.408,78	321.981,28
3.6.	Organization of procurement procedures	-	-	-
3.7.	Advice	618.773,00	117.566,87	736.339,87

	3.7.1. Project management for the investment objective	606.475,00	115.230,25	721.705,25
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	3.8.2. Site management	82.647,00	15.702,93	98.349,93
Total chapter 3		1.472.701,42	279.813,27	1.752.514,69

4. Analysis of each/fifth technical-economic scenario/options proposed

Analysis of each proposed technical-economic scenario/options

4.1 Presentation of the analysis framework, including specification of the reference period and presentation of the baseline scenario

The reference period taken into account is 20 years, including the project implementation period. The implementation period of the project is foreseen to be 2024-2025 and the operational period 2026-2045, but in the annexes reference will be made only to the year number (year 1, year 2, ..)

The appropriateness of the project is given by the economic analysis or cost-effectiveness analysis as appropriate. By various methods non-monetary benefits (qualitative or physical) are included in the analysis to show the usefulness of the project or in the case of cost-effectiveness analysis, to determine the higher usefulness of one project variant over another.

The two scenarios analyzed are the following:

Scenario 1:

To generate the desired quantity of approx. 1000 nmc/h of hydrogen, the plant consists of 2 container modules, each with a PEM electrolyzer of 2.5 MW (installed electrical power). The infrastructure will have a hydrogen production capacity of 3.02 Mw.

Scenario 2:

To generate the desired quantity of approx. 1000 nmc/h of hydrogen, the plant consists of 5 container modules, each with a 1 MW PEM electrolyzer (installed electrical power). The infrastructure will have a hydrogen production capacity of 3.02 Mw.

4.2. Analysis of vulnerabilities caused by anthropogenic and natural risk factors, including climate change, that may affect the investment

Climate projections

The climate projections are based on the document issued by the IPCC - WORKING GROUP III CONTRIBUTION TO THE IPCC SIXTH ASSESSMENT REPORT (AR6) - Climate Change 2022.

The following table shows the classification of climate-related hazards based on the risks listed in Appendix A: Classification of climate-related hazards to the Commission Delegated Regulation (EU) (C (2021) 2800/3).

	Temperature risks	Wind risks	Water-related risks	Solid mass risks
Chronicles	Temperature change (air, freshwater, seawater)	Changing wind regime	Change in precipitation patterns and precipitation types (rain, hail, snow/ice)	Coastal erosion
	Heat stress		Precipitation or hydrological variability	Soil degradation
	Temperature variability		Ocean acidification	Soil erosion

	Melting permafrost		Saline intrusion	Singleflow
			Sea level rise	
			Water stress	
Acute	Heatwave	Cyclone, hurricane, typhoon	Drought	Avalanche
	Cold/freezing	Storm (including blizzards and dust and sand storms)	Heavy precipitation (rain, hail, snow/ice)	Landslide
	Forest fire	Tornado	Flooding (coastal, fluvial, pluvial, underground)	Subsidy
			The sudden emptying of glacial lakes	

Stage 1:

Based on the risks listed in Appendix A: Classification of climate-related hazards to the Commission Delegated Regulation (EU) (C (2021) 2800/3), **those climate risks that may affect the performance of the economic activity over its expected lifetime will be identified**

The probability of risk occurrence has been grouped into 5 categories as follows:

- None;
- Reduced:
- Average;
- Raised;
- Imminent;

The intensity of impact if a risk would occur has also been grouped into 5 categories as follows:

- N/A - where there is no probability of the risk occurring;

- Low - impact considered normal, within the moral and physical wear and tear of the equipment;
- Medium - slightly high impact;
- High - causes major malfunctions of equipment and therefore of the activity;
- Devastating - causes complete destruction of equipment;

With the exception of non-existent risks, all risks are considered to be considered to be capable of affecting the performance of the economic activity at some point in time over its expected lifetime, the only variable being the need to adapt the infrastructure to protect the expected economic performance.

The entire analysis will answer the following question: If, after analyzing the likelihood of occurrence of the risk and its intensity, the measure is expected to increase the negative effect of the current and expected future climate on the measure itself or on people, nature or assets? Thus, only those risks are considered significant for which the answer to the above question is YES.

It should also be noted that the analysis also takes into account the forecasts of how the infrastructure will be operated, the forecasted economic results and the elements that have been taken into account in the calculation of these forecasts.

Risc	Probability	Intensity	Comments
Chronic temperature-related risks			
Temperature change (air, freshwater, seawater)	REDUCED	MEDIA	The probability of air temperature change is relatively low. The change in water temperature is relevant to this project.
Heat stress	REDUCED	SCĂZUTĂ	Heat stress is increasing and the climate models taken into account indicate increasing heat stress. Their impact on economic activity remains relatively small and is taken into account in annual productivity.
Temperature variability	REDUCED	SCĂZUTĂ	Temperature variability includes all climate variations that last longer than individual weather events - being relatively small in duration to impact economic activity.
Melting permafrost	NONE	N/A	This is not the case - there is no permafrost at the project location.
Acute temperature-related risks			
Heatwave	REDUCED	SCĂZUTĂ	The implementation of the project implies the realization of a hydrogen production capacity - the change of the temperature regime does not generate economic risks.

Cold/freezing	REDUCED	SCĂZUTĂ	The cold/freezing spell causes a slight decrease in economic performance but this is taken into account in the forecast economic models
Forest fire	NONE	N/A	The implementation of the project is not carried out in the vicinity of the forest, so the risk is non-existent.
Chronic wind risks			
Changing wind regime	NONE	N/A	The implementation of the project implies the realization of a hydrogen production capacity - the change of the wind regime does not generate economic risks.
Acute wind risks			
Cyclone, hurricane, typhoon	NONE	N/A	The project area is not exposed to hurricanes or typhoons.
Storm (including blizzards and dust and sand storms)	MEDIA	SCĂZUTĂ	The risk of a storm is medium, with a few storms more than certain to occur over 20 years. In terms of economic performance, however, this is taken into account in the calculation of the projected financial models
Tornado	REDUCED	MEDIA	The risk of a tornado is low - with relatively few tornadoes expected in Romania.
Chronic water-related risks			
Change in precipitation patterns and precipitation types (rain, hail, snow/ice)	NONE	N/A	The implementation of the project involves the realization of hydrogen production capacity - the change of precipitation regime does not generate economic risks.
Precipitation or hydrological variability	NONE	N/A	The implementation of the project involves the realization of hydrogen production capacity - hydrological variability does not generate economic performance problems.
Ocean acidification	NONE	N/A	The implementation of the project has nothing to do with ocean acidification and economic performance will not be impacted in any way in this respect.
Saline intrusion	NONE	N/A	The implementation of the project is not related to saline intrusion, the economic performance will not be impacted in any way from this point of view.
Sea level rise	NONE	N/A	The implementation of the project has nothing to do with sea level rise, economic performance will not be impacted in any way in this respect.
Water stress	NONE	N/A	The implementation of the project is not related to water stress, the economic performance is not impacted in any way from this point of view.
Acute water-related risks			
Drought	REDUCED	SCĂZUTĂ	The implementation of the project implies the realization of a hydrogen production capacity - the change of the soil moisture regime does not generate economic risks.
Heavy precipitation	REDUCED	MEDIA	The implementation of the project implies the realization of a

(rain, hail, snow/ice)			hydrogen production capacity - the change of precipitation regime does not generate economic risks.
Flooding (coastal, riverine, pluvial, underground)	EXISTS	N/A	This is not the case.
The sudden emptying of glacial lakes	NONE	N/A	This is not the case.
Chronic solid mass risks			
Coastal erosion	NONE	N/A	This is not the case.
Soil degradation	MEDIA	Low	The implementation of the project involves a medium risk of soil degradation.However, the project is not realized in an agricultural area, the intensity of this risk is low. In terms of economic performance - it is not influenced by soil degradation.
Soil erosion	NONE	N/A	In terms of economic performance - it is not influenced by soil erosion.
Singleflow	REDUCED	Environment	. The implementation of the project implies the realization of a hydrogen production capacity - the change of the Soliflux component does not generate economic risks.
Acute solid mass risks			
Avalanche	NONE	N/A	The project location is not in an avalanche prone area.
Landslide	NONE	N/A	The topographic study attached to this documentation indicates a non-existent risk of landslides.
Subsidy	NONE	N/A	Subsidence occurs as a result of activities such as mining or other subsurface interventions and involves the successive lowering of the earth's crust. The present project is not being carried out in such areas and there is no risk of subsidence.

Step 2: Climate risk and vulnerability assessment to determine whether physical climate risks are significant for the economic activity in question

Next, in order to be able to determine whether any of the risks analyzed above **are significant** for the economic activity, they have been rated according to the category to which they belong.

Score:

Probability risk		**Risk intensity**	
None	0	N/A	0
Reduced	1	Low;	1
Average	2	Average;	2
Retrieved	3	Raised;	3

Imminent	4	Devastating	4

In order for a climate risk to be considered significant, it must score a minimum of 5 points, the sum of the two elements analyzed - probability and intensity.

The following table presents the scores obtained by the previously analyzed risks according to the two analyzed elements - risk and intensity.

	RISK NOTE	INTENSITY NOTE	FINAL NOTE
Chronic temperature-related risks			
Temperature change (air, freshwater, seawater)	1	2	3
Heat stress	1	1	2
Temperature variability	1	1	2
Melting permafrost	0	0	0
Acute temperature-related risks			
Heatwave	1	1	2
Cold/freezing	1	1	2
Forest fire	0	0	0
Chronic wind risks			
Changing wind regime	0	0	0
Acute wind risks			
Cyclone, hurricane, typhoon	0	0	0
Storm (including blizzards and dust and sand storms)	2	1	3
Tornado	1	2	3
Chronic water-related risks			
Change in precipitation patterns and precipitation types (rain, hail, snow/ice)	0	0	0
Precipitation or hydrological variability	0	0	0

Ocean acidification	0	0	0
Saline intrusion	0	0	0
Sea level rise	0	0	0
Water stress	0	0	0
Acute water-related risks			
Drought	1	1	2
Heavy precipitation (rain, hail, snow/ice)	1	2	3
Flooding (coastal, fluvial, pluvial, underground)	0	0	0
The sudden emptying of glacial lakes	0	0	0
Chronic solid mass risks			
Coastal erosion	0	0	0
Soil degradation	2	1	3
Soil erosion	0	0	0
Singleflow	1	2	3
Acute solid mass risks			
Avalanche	0	0	0
Landslide	0	0	0
Subsidy	0	0	0

It can therefore be seen that there is no significant risk to the economic activity carried out that would require additional measures to be taken. All risks have a score of less than 5 points, the effect of the occurrence of these risks being taken into account in forecasting the revenues of the economic activity.

In conclusion - the climate risk and vulnerability assessment did not identify any risks whose likelihood and intensity of impact would require adaptation of infrastructure to climate change, other than those already taken into account and visible in the evolution of the financial indicators of the activity carried out.

If significant changes in the assumptions used in climate projections are identified in the short or medium term under a number of future scenarios (described at the beginning of this paragraph) - the company's management will consider identifying adaptation solutions by taking the following steps:

- *Conduct an assessment of* ***adaptation solutions*** *that can reduce the identified physical climate risk.*
- *Implementation of the identified physical and non-physical solutions ('adaptation solutions') that substantially reduce the most important* ***significant physical climate risks*** *to the economic activity.*
- *Assumption that the identified solutions* ***do not adversely affect the adaptation efforts or the level of resilience to climate-related physical risks of other people, nature, other assets and/or other economic activities*** *and that* ***they are consistent with national climate change adaptation plans and strategies at local, zonal, regional or national level.***

4.3 Utility situation and consumption analysis

The proposed project requires the following utilities:

Water - this will be provided from water sources owned by the beneficiary at the proposed location.

Electricity - this will be provided through the existing connection and by the applicant's own PV system on site and possibly elsewhere through dedicated supply contracts.

Consumption is :

Water: 10 l/kg $H_{(2}$

Electricity : 7.200 MWh / year

4.4. Sustainability of the investment objective:

a) social and cultural impact, equal opportunities;

The project complies with all related provisions regarding the principles of gender equality. The implementation of the project will imply the creation of a new job, which will be realized in accordance with the Law 202/2002 (and the rest of the legislation in force) on equal opportunities.

Thus, the new employee of the company will be chosen on the basis of performance and intellectual capacity to cope with the imposed rigors, not on the basis of criteria such as gender. All people will have equal opportunities to fill the post in the future organization chart, with the selection based solely on professional skills and abilities.

b) estimates of the workforce employed by the realization of the investment: in the realization phase, in the operation phase;

During the realization of the investment, the responsibility of the workforce will fall on the supplier of the products to be installed. It is estimated that between 2 and 7 people will be directly involved in the realization phase of the investment.

The operation of the investment will be realized with the existing staff of the beneficiary.

c) impacts on environmental factors, including impacts on biodiversity and protected sites, where appropriate;

The impact on environmental bills is minimal.

At the same time, the investment in this project will not affect:

- arable and cultivated land with moderate to high levels of soil fertility and underground biodiversity,
- land that is recognized as having a high biodiversity value and land that serves as habitat for endangered species (flora and fauna); and
- forest land (whether or not covered by trees), other wooded land or land that is partly or entirely covered or intended to be covered by trees, even if these trees have not yet reached the size and cover necessary to be classified as forest or other wooded land as defined according to the FAO definition of forest.

d) the impact of the investment objective in relation to the natural and man-made context in which it is integrated, where appropriate.

This is not the case.

4.5. Analysis of the demand for goods and services justifying the sizing of the investment objective

Since the second half of 2021, there has been a sharp jump in energy prices in the EU and worldwide. Reiterating the previous chapters, to some extent this was to be expected in the context of the post-COVID-19 economic recovery and the easing of travel restrictions, but nevertheless, energy prices have risen more than anticipated.

The increase in 2021 was totally unprecedented. Energy import prices, although quite volatile, have not changed by more than about 30% per year in the past, while between December 2020 and December 2021 energy imports cost more than double the previous year.

Russia's military aggression against Ukraine, which began on February 24, 2022, has further disrupted energy markets, increasing pressure on prices, especially for gas and oil, and raising concerns about the security of energy supply in the EU.

Increasing the share of renewable energy in different sectors of the economy and in particular in the SME sector is therefore a key element for achieving the EU's energy and climate targets.

The project will help address one of the main challenges of the SME sector in Romania in terms of decarbonization and air pollution, namely ensuring the green transition of the SME sector by promoting renewable hydrogen production, energy efficiency and future technologies.

The effective decarbonization of the economy and industry implies the use of hydrogen as an energy carrier and calls for an updated and user-friendly legal framework, which needs to be smoothly integrated into the current legislation.

Energy and raw materials used for hydrogen production are preferably local. Local production of hydrogen can support intermittent renewable energy management and at the same time could keep the added economic value locally or regionally while avoiding external energy dependency on fossil fuels.

4.6. Financial analysis, including calculation of financial performance indicators: cumulative cash flow, net present value, internal rate of return, financial sustainability

The purpose of this chapter is to calculate the financial performance indicators for the two scenarios detailed in this Feasibility Study, generically referred to as Scenario 1 and Scenario 2, in order to determine which of these is financially optimal for implementation.

In terms of the structure of this chapter the following will be realized:

- Presentation of assumptions - general for both scenarios analyzed;
- Outline the expenditure for each scenario;
- Presentation of the revenues for each scenario;
- Calculation of financial performance indicators: cumulative cash flow, net present value, internal rate of return and financial sustainability.
- Annexes containing the full tables for the two scenarios - attached at the end of this feasibility study.

Presentation of hypotheses:

The following assumptions apply to both scenarios:

- The time horizon of the analysis is 22 years as follows:
  - Project implementation period - 2 years;
  - Project operating period 20 years, during which time revenues and operating costs are expected;
- All amounts shown are in lei. If another currency is used, this is indicated separately;
- VAT amount - 19%;
- The discount rate is estimated in line with the EC CBA Guide 2014-2020 which recommends the use of the **financial discount rate of 4%,** the **social discount rate of 5%** for major projects in Cohesion Fund beneficiary countries (including Romania).
- The analysis is carried out at constant prices - with 2024 as reference period;
- Both costs and revenues do not take into account the influence of inflation - in line with the European Guide to Cost-Benefit Analysis and the Guide for Applicants;

For both scenarios, the **incremental principle** is taken into account, and they are reported to the "without project" scenario. Thus the analysis strictly highlights the project indicators without them being altered by other actions of the beneficiary. At the same time, this approach complies with the specific requirement of the Guidelines for Applicants - "the project must clearly be an independent unit of analysis".

- Prices (revenues and costs) will be held constant for the whole period of analysis. It is considered that the duration of the analysis - 22 years - is extremely long to be able to estimate the direction in which the economic environment will go. Both prices and costs can go up or down (as they have over the last 20 years) which is why the "constant" scenario is as viable as any other scenario. At the same time, keeping all elements constant eliminates the risk of subjectivity and gives much greater transparency in determining project indicators.
- The analysis is carried out according to the **economic principle of prudence** - costs are presented in a slightly overstated way and revenues in a slightly pessimistic way.
- The analysis of the two scenarios takes into account only the impact of the project, without assessing in any way the situation of the company. The project is therefore **an independent unit of analysis**, complying with the requirements of the Guidelines for Applicants.

Project costs:

Project costs are scenario-specific and are composed of the following categories of expenditure:

- **Total investment costs** - include both capital costs and costs related to project implementation that will not be capitalized (e.g. costs of preparing financing documentation, project management costs, publicity and information costs, project audit costs, etc);
- **Replacement costs** - include the cost of replacing equipment with an economic lifetime shorter than the project baseline period;
- **Operating costs** - includes all costs generated by the operation and maintenance of the new or upgraded infrastructure.

Investment costs :

The following table shows the investment costs:

Investment costs	SCENARIO 1	SCENARIO 2
Cost Ex VAT	51.315.207,43	55.880.569,20
VAT	9.616.216,18	10.483.634,91
Cost including VAT	60.931.423,60	66.364.204,11

The breakdown of costs by component can be found in the cost estimates for each scenario.

These costs are realized only once - during two calendar years called the project implementation period. In the attached documents the project implementation period is **Year 1 and Year 2.**

Replacement costs

The technical infrastructure for green hydrogen production consists of several technical components - each with a distinct lifetime. At the moment it is not known which supplier or model of equipment will be purchased, so it cannot be accurately determined how long the equipment will operate. Although the accounting life of this equipment is a different thing from the operating life - we believe that at this point in time (bid preparation) the most transparent way to determine the value and timing of replacement costs is to refer to the life as set out in the fixed asset life nomenclature.

The following table shows the 2 components of the green hydrogen system and their lifetimes, including the selected lifetimes for Scenario 1 and Scenario 2 respectively.

Project components	Amortization period (years)	Duration (years)	Scenario 1 (lei)	Scenario 2 (lei)
Buildings and similar structures	1.3.1 (25-35)	24,00	2.860.652,32	3.146.717,55
Electrolyzer	2.1.16.5. (8-30)	24,00	39.501.000,00	43.451.100,00
Total chapter 4.1		**TOTAL**	42.361.652,32	46.597.817,55

In conclusion, the lifespans of the equipment presented are identical to the operating life of the investment - 20 years, with no replacement costs necessary. Moreover, it will be possible to observe a sharp decrease in the efficiency of the infrastructure in the last years of operation, another effect of the fact that no replacement costs will be realized during the analysis period.

Operating costs

Operating costs are those costs necessary to ensure that the technical infrastructure can operate at optimal parameters throughout the analysis period. These costs will be realized over the 20 years of operation, i.e. from year 3 to year 22.

Operating costs are divided into two categories as follows:

- Fixed costs - independent of the installed capacity or the amount of green hydrogen the system will produce;
- Variable costs - dependent on either the installed capacity of the infrastructure or the amount of energy the system will produce per year;

Fixed costs:

The following categories of fixed costs have been identified as follows:

Personnel costs

Three full-time jobs will be created for staff to oversee the green hydrogen production infrastructure. Employee costs will be kept constant throughout the analysis period and are similar for the two scenarios analyzed.

Personnel costs	Individual monthly salary	Employees	Total annual salary
Scenario 1	8.000	3	288.000
Scenario 2	8.000	3	288.000

Infrastructure maintenance costs:

Represents annual costs of ensuring the continuous and constant operation of the technical infrastructure for the production of green hydrogen. Annual costs are estimated as follows:

Infrastructure maintenance costs	Installed electrical capacity (MW)	Preventive maintenance (lei/mw)	Annual cost scenario (lei)
Scenario 1	3,02	212.397	641.440
Scenario 2	3,02	231.294	698.507

These costs are similar for the two scenarios analyzed (in the context of similar installed capacity) and are held constant for the whole analysis period.

Variable costs:

They represent costs that are influenced by the amount of the investment and its installed power. In the production of green hydrogen - the most important cost is the cost of electricity needed to run the electrolyzers.

Electricity needs

For a production of 3.02 Mw of green hydrogen, this results in an electricity requirement of 6 Mw, an assumption valid in both scenarios analyzed. The electricity requirement will remain constant throughout the analysis period as the production obtained will gradually decrease from year 10 of operation due to wear and tear of the purchased equipment.

Electricity costs	U.M.	Installed electrical power electrolyzer	Need electricity
Scenario 1	Mw h	2 x 2,5	6
Scenario 2	Mw h	5 x 1	6

Converting the above into kw/kg gives an hourly electricity consumption as shown in the following table:

Electricity costs	U.M.	Need energy	Energy needs/year (Mw)
Scenario 1	Kw/kg	66,76	7.200

Scenario 2	Kw/kg	66,76	7.200

In the above, the assumption presented in the revenue section has been taken into account, i.e. an average hourly production of 89.88 kg and an annual infrastructure operation of 1,200 hours/year.

Recall that from year 10 of operation of the infrastructure (year 3 of the analysis) - the production capacity will start to lose its efficiency, with an energy consumption of 7,200 MW less green hydrogen will be produced than in year 1. This will imply a higher electricity demand/kg but will not influence the annual electricity demand - which will remain constant at 7,200 Mw h.

The influence of the decrease in electrolyzer efficiency on the level of investment is shown in the revenue section.

In order to obtain the 7,200 Mw H annual electricity needed for the production of green hydrogen, the following sources are considered: suppliers and producers of electricity produced from renewable sources in the area.

Compliance with the conditions of the draft Regulation supplementing Directive EU 2018/2001 on the metering of energy consumed for the production of energy from renewable sources, both own and grid energy (Articles 3 and 4) will be taken into account.

For the energy purchased from the grid, according to the Romanian legislation, commercial agreements can be made in the form of an energy sales agreement, as well as in the form of updating the supply contract, in the sense of requiring a supplier to request that the energy delivered comes entirely from renewable sources, Inspet will have to use both options for the energy purchased from the grid and use them as needed.

The following table shows the specific annual electricity requirements for each scenario - depending on the electricity source. As mentioned above, the electricity demand will be kept constant throughout the infrastructure operation period.

		Scenario 1	Scenario 2
Total electricity	Mw h	7.200	7.200

Electricity - photovoltaic park	Mw h	5.040	5.040
Electricity SEN	Mw h	2.160	2.160

The projected cost of electricity purchase differs depending on the source of electricity. Thus, the cost that the beneficiary of the project currently pays for the energy coming from NES has been taken into account for the energy coming from renewable energy, while for the energy coming from renewable energy, the cost of operating the infrastructure has been taken into account, the value being related to the current needs.

	U.M.	Scenario 1	Scenario 2
Electricity - photovoltaic park	Mw h	5.040	5.040
Cost	You	204	204
Total electricity cost - photovoltaic park	You	1.027.971	1.027.971
Electricity - SEN	Mw h	2.160	2.160
Cost	You	500	500
Total electricity cost - SEN	You	1.080.475	1.080.475
Total electricity costs	You	2.108.446	2.108.446

As in the case of the quantity of electricity, the costs of electricity required will be kept constant over the period of analysis.

How electricity costs are determined:

Cost of photovoltaic energy - 204 lei/Mw

The estimated cost is 204 lei/ Mw produced and is based on the following:

In order to obtain the 5,040 MWh of photovoltaic energy, it is necessary to have a capacity of 4.8 Mw of installed capacity. The following table shows the estimated annual costs of a photovoltaic electricity production infrastructure. Other costs include items such as site maintenance, repairs, replacements, Opcom fees, ANRE fees, accounting, security, etc.

	Annual cost
Insurance	177.500
Preventive maintenance	295.000
Salaries	180.000
Imbalance	275.000
Other costs	100.000
Annual total	1.027.500

As mentioned throughout the documentation - **5,040 MW** h of electricity is expected to be produced annually. By relating the estimated costs detailed above to the projected 5,040 MWh, a cost of 204 lei/MWh - as presented in the project documentation - results.

Energy purchased from SEN - 500 lei/Mw

The determination of the cost of electricity purchase was based on the average price the average closing market price for the next day of July 2023 - **estimated at 500,22lei**. For easier and transparent presentation, the cost in question was estimated at 500 lei.

As all infrastructure operating costs have been presented, in the following table they will be presented centralized for year 1 of operation (year 3 of the analysis). A detailed breakdown of these costs (including equipment replacement costs) can be found **in the** chapter specific **annexes CBA , Table 4.2.- attached to this feasibility study.**

Tip cost	U.M.	SCENARIO 1	SCENARIO 2
Total electricity expenditure (existing photovoltaic park)	You	1.027.971	1.027.971
SEN electricity cost	You	1.080.475	1.080.475
Maintenance work	You	641.440	698.507
Staff employed	You	288.000	288.000
Total expenditure	You	**3.037.886**	**3.094.953**

In addition to the costs presented, there are a number of other costs, namely depreciation. These have no influence on the operability of the project and are only necessary in determining the corporation tax paid by the company - visible in Table 8 Financial Sustainability.

The amortization is found in chapter 4.3. of the annexes - Cost Benefit Analysis and has been carried out according to the following reasoning:

- Only the own-contribution component of the depreciation of the investment is taken into account in the calculation of corporate income tax;
- The amortization percentage - related to the requested non-reimbursable financial assistance is not taken into account in the calculation of corporate income tax.
- From year 14 onwards - equipment requiring replacement is considered exclusively as an own contribution and its depreciation is taken into account when determining corporation tax.

Revenues

Operating revenues - include cash inflows paid directly by users for goods or services in the operation, such as fees/charges incurred directly by users for the use of infrastructure, sale or rental of land or buildings, or payments for services. Revenues will be determined on the basis of the quantities sold or services rendered/savings in operating costs generated by the operation forecast over the project reference period and on the basis of specific prices, taking into account the conclusions of the demand analysis/own consumption analysis.

The revenues that the company will earn as a result of project implementation are realized over the period of operation - years 3 -22 in the attached analysis. The revenues of the infrastructure will be presented taking into account the 3 fundamental elements of revenues, namely product, quantity and price.

Product :

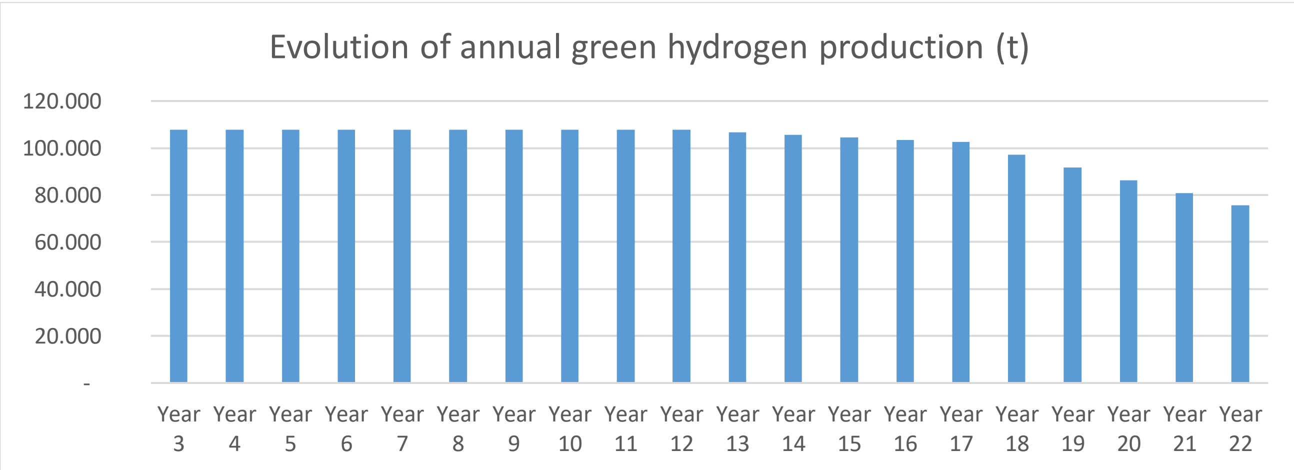
The implementation of the project will, in both scenarios, generate a single type of product at societal level:

- Revenues from green hydrogen production - sold to SEN..;

Quantity:

It represents the most volatile element of the project - in the sense that the production realized by the company decreases annually, due to the slight physical degradation of the technical infrastructure, which is true for both scenarios analyzed.

Thus, for both Scenario 1 and Scenario 2 the evolution of the amount of energy produced by the technical infrastructure is as follows:



The following table shows the amount of green hydrogen that will be produced by the new infrastructure - according to the two scenarios considered.

	Installed capacity (Mw)	Annual production year 3 (TONES)	Annual production year 20 (TONES)
Scenario 1	3,02	107,856	75,499
Scenario 2	3,02	107,856	75,499

Each year, the amount of energy the company produces decreases - in line with the forecasts in the technical section of this feasibility study.

Price:

Price is the most important element of the whole financial analysis, and overestimating it can cause wrong investment decisions. The following table shows the expected price for the two scenarios analyzed:

	Scenario 1	Scenario 2
Green hydrogen - lei/kg	65	65

How the selling price of hydrogen is determined

The determination principle was by applying a profit margin of 10% to the cost of production. It was considered that, both in the light of the strategic documents containing the European Union's energy policies (GREEN DEAL) and Romania's programmatic documents, green hydrogen will become extremely attractive in terms of fair cost sharing to polluters, which will make the purchase of energy from alternative sources expensive. The European Union has also announced plans to set up a European hydrogen bank, which would ensure that the green hydrogen produced is sold at a competitive price.

The determination of the selling price of hydrogen is based on the technology study - The Future Of Hydrogen; Seizing today`s opportunities which highlights that the **cost of producing one kg of hydrogen by electrolysis varies between 3 and 7.5 dollars** and is generally three times higher than the cost of producing gas. Given that the time of the project is August 2023 and applying the influence of inflation, it can be estimated that the variation of the production cost is 1.5 - 2 times higher, resulting in a cost between 6 and 15 dollars. A similar result was reached in the project documentation, where the production cost is 28 lei/kg (about 7 dollars) (cost year 1 : 3,037,886 lei - to obtain 107,856 kg H).

The estimated cost of obtaining hydrogen was added to the cost of amortization of the investment - 23.7 lei/kg (51,315,207 lei amortized over a period of 20 years - the duration of analysis - 2,565,670 lei / year. The 107,856 kg of the 107,856 kg gives 23.7 lei/kg) - giving a total cost of 51.7 lei/kg. To this cost was added the profit margin of the project beneficiary 25%: 13 lei **= 64.7 lei. (adjusted to 65 lei).**

In conclusion, having detailed all the elements, in the following table the company's revenues for each scenario can be presented, both for the first year of operation (year 3) and for the entire period of operation of the investment.

	U.M.	Scenario 1	Scenario 2
Annual production (years 3-12)	Tone	107,856	107,856
Annual revenues (years 3-13)	You	7.010.640	7.010.640
Annual production (years 13-22) - average value	Tone	95,4526	95,45
Annual income (years 13 - 22) - average value	You	6.204.416	6.204.416
Total revenue (operating period)	**You**	132.150.564	132.150.564

A breakdown of the revenues can be found in the chapter-specific CBA annexes (Table 4.1.) attached to this documentation.

Residual value:

In the present case, the lifetime value of the investment is estimated at 20 years while the years of operation presented in the cost-benefit analysis are also 20, with no additional operating period. In conclusion, for both scenarios - the residual value of the infrastructure is predicted at **0 lei**.

Calculation of performance indicators

The financial profitability of the investment can be assessed by estimating the financial net present value (NPV) and the financial rate of return on investment (FIR). These indicators show the ability of the net revenue to cover the investment costs, regardless of how it is financed. In order for a project to be considered eligible for co-financing from the Funds, the NPV must be negative and the IRR must be lower than the discount rate used for the analysis.

The financial profitability of the investment was determined by estimating the financial rate of return on investment (FIRR) based on the discounted net discounted cash flow with a discount rate of 4% and calculating the discounted net investment income.

The internal rate of financial return on investment is calculated by considering the total costs of the investment as an output (together with operating costs) and the benefits (including residual value) as an input.

The cash flows used in the RIRF/C and NPVF/C calculations can be found in Chapter 9 of the Annexes - Cost Benefit Analysis.

The calculation formulae to determine the two indicators are as follows:

In the case of net present value (FNPV - in the following image):

$$\text{FNPV(C)} = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \ldots + \frac{S_n}{(1+i)^n}$$

In the case of the Internal Project Rate of Return (IRR) in the following image:

$$0 = \sum \frac{St}{(1+FRR)^t}$$

waves:

- FNPV (C) is NPV - financial net present value;
- FRR is RIR;
- S is the cash flow for each year ;
- i - discount rate; in the case of the analyzed investment, the discount rate selected for the NPV calculation is 4%.
- 0-n - number of years of the investment realization period (1-22);
- t - the number of years of the expected operating period, in this case 22 years;

Income and expenses for the financial analysis include:

a) the base is the initial investment, given by the total amount of the investment budget;
b) residual value is the final value of the investment at the end of the forecast period;
c) cash flow:

- **annual**, is the difference between annual cash inflows (receipts) and outflows;
- **initial**, is the initial investment made, considered as a cash outflow occurring in years -1 and 0;
- **the final**, is the final (or residual - after the forecast period) value of the investment, the present value of which increases the sum of the discounted cash flows;

d) the discount rate brings the future cash flows (initial, final and annual) to the values at the base point in time of the investment, year -1;

(e) discounted cash flow is the correction of the cash flow by the discount factor, i.e. bringing the values to the time of the investment.

The financial net present value of the investment is determined in Table 9 Profitability and return on investment in the annexes Cost Benefit Analysis.

	Scenario 1	Scenario 2
RIRF/C	3,37%	2,29%
NP NPV/C	- 2.727.397,36	- 7.801.714,75
Value for money	0,88	0,84

The value of the RRF/C indicator shows whether EU co-financing does not exceed the monetary value that makes the project cost-effective, in order not to generate a case of over-financing. Thus, NPVF(C) before EU contribution should be negative and RRF(C) should be lower than the discount rate used for the analysis.

In the present case, in both scenarios the NPV (C) is negative and the RRIR/C is below the discount rate (of 4%), resulting in both scenarios requiring financing.

<u>Return on invested capital</u>

In the following paragraphs we will determine the indicators related to the return on invested capital, i.e. RIRF/K and NPVF/K respectively. These indicators should not be confused with RIRF/C and NPVF/C (which determine the need for financing) - they are complementary. Unlike the first indicators which take into account the value of the investment regardless of the sources of co-financing, those presented in the current section take into account strictly the capital invested by the project beneficiary, excluding the contribution of the applicant from the requested grant.

	Scenario 1 (lei)	Scenario 2 (lei)
Investment	**51.315.207,43**	**55.880.569,20**
Non-reimbursable financial assistance	**33.944.550,00**	**37.336.752,50**
Capital invested - beneficiary	17.370.657,43	18.543.816,70

In terms of the formulas used, they are identical to the previous ones:

- to calculate the Net Present Value respectively (FNPV/K)

$$\text{FNPV(C)} = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \dots + \frac{S_n}{(1+i)^n}$$

to calculate the project's Internal Economic Rate of Return. (FRR)

$$0 = \sum \frac{St}{(1+FRR)^t}$$

The difference arises from the fact that in this case, the investment takes into account only the cost borne by the beneficiary - its own contribution to the implementation of the project and additionally (if applicable) the cost of this contribution - quantified by the **total amount of interest paid**.

	Scenario 1	Scenario 2
RIRF/K	**18,28%**	**16,86%**
NPV/NNAF/K	**29.503.958,35**	**27.658.872,28**

In textbooks, the RIRF/K is compared to the bank interest rate on a deposit, indicating the difference between investing the money in one of the two scenarios or forming a bank deposit for 20 years. There is no one value that indicates a clear-cut decision, as this involves a number of subjective factors (including individual risk exposure). The higher the RIRF/K value, the more a potential investor is more likely to decide to undertake the project at hand at the expense of locking money in a bank deposit to earn interest as income. In conclusion, with higher profitability indicators, **scenario 1 is more profitable** than scenario 2 for the project beneficiary.

Financial sustainability (including cumulative flow)

- The financial sustainability of the project is ensured by verifying that the cumulative (undiscounted) net cash flow is positive (or equal to zero) for each year and over the whole reference period considered;
- The net cash flows that are taken into account for this purpose have taken into account investment costs, all financial resources (EU co-financing, bank loans, grants, budget allocations), cash receipts, operating and replacement costs at the time they are paid, repayments of the entity's financial obligations as well as capital injections, interest and direct taxes;
- In determining financial sustainability, the residual value was not taken into account as the asset was not liquidated in the last year of analysis.

Financial sustainability is also linked to:

- the investment realization schedule versus monthly cash flow projection over the period of the investment realization;
- Financing plan and anticipated sources, with detailed loan repayment schedules, cost of borrowing, schedule of expense claims incurred, versus annual cash flow projection over the operating period.

In addition to the operating revenues and expenses presented, the sustainability framework also took into account the corporate income tax paid by the company in each year of operation, estimated at 16% of the cash surplus to which investment amortization has been added).

From the analysis of the cash flows recorded at the end of each year, it emerges ***that in both scenarios, the project is viable due to the availability of financing sources to cover the project costs***

4.7. Economic analysis, including calculation of economic performance indicators: net present value, internal rate of return and cost-benefit ratio or, where appropriate, cost-effectiveness analysis

According to the provisions of HG 907, in the case of investment objectives whose total estimated value does not exceed the threshold for which the technical-economic documentation is approved by Government Decision, according to the provisions of Law no. 500/2002 on public finance, with subsequent amendments and additions, **the cost-effectiveness analysis is developed**. Given the clear provisions of the Applicant's Guide - which states "The cost-effectiveness analysis to be included in the structure of the Feasibility Study **is not sufficient to justify a project**, even if it provides **information in order to select an option**, it does not provide anything on the financial sustainability of the project / selected alternative. In this respect it is necessary that the Cost Benefit Analysis document is prepared in **accordance with the provisions of the EC CBA Guidelines 2014 -202020**."

In conclusion, this chapter will carry out an **economic analysis** (or cost-effectiveness analysis), the results of which will provide the necessary information to **select an option**. The aim of this chapter (and thus of the feasibility study) will be achieved - the final results will allow **an option selection to be made.**

The economic analysis measures the economic, social and environmental impact of the project and assesses the project from a societal point of view. The objective of the economic analysis is to demonstrate that the project has a **net positive contribution to the SME sector** and is therefore worth financing. The feasibility analysis presented above considered only the direct financial effects of the investment on the beneficiary's assets. Given that the investment project does not exclusively have a profit objective as such, it is appropriate to give greater weight to

The methodology used to assess the contribution of the project to the economic and social well-being of the population as a result of the implementation of the investment is in line with the **EC 2014-2020 Guidelines for cost-benefit analysis for investment projects.** The steps taken into account to determine the economic profitability indicators are presented in the following paragraphs:

- ***Making tax corrections***

Value added tax and social security payments have been excluded from the calculation in the assessment of inputs and outputs. These values have not been taken into account at any point in this

Cost Benefit Analysis. In addition, as in the case of the financial analysis, the influence of inflation or consumer price increases has not been taken into account.

- ***Correction of externalities***

It aims to determine the external benefits and costs (externalities) that have not been taken into account in the financial analysis. Although these can be easily identified, they are difficult to quantify and, in this situation, need to be listed in order to provide the decision-maker with elements to take the decision. As a general rule, every social cost or benefit that is passed on to other subjects in the absence of compensation should be accounted for at this stage. According to the **EC 2014-2020 Cost-Benefit Analysis Guide for Investment Projects** for the investment at hand, the recommended externalization correction factors are **1**.

- ***Valuation of inputs and outputs in accounting prices***

Apart from fiscal influences and externalities, real prices are distorted by market mechanisms. The valuation of inputs and outputs in accounting prices is carried out using conversion factors. The use of conversion factors is due to the fact that input and output prices do not reflect their social value due to market distortions (monopoly, trade barriers and others).

Due to its macro-economic nature, the calculation of conversion factors is carried out by a **national planning office** and not project by project. In this case, the recommendations of the methodologies in force were taken into account, with the exception that the nature of this project is atypical. The two conversion factors used in this case are as follows:

- Standard investment conversion factor (Ev - Investment) - **0.81;**
- Shadow Labor Price (Ev - Operational) - **0.674**;

The first indicator will be used to **determine all externalities during the implementation period of the project** while the second indicator will be used to **determine all externalities during the operation period of the investment**.

In the following paragraphs, the steps outlined above, specific to this project, are repeated.

Assessing externalities

In the case of this projectboth positive and negative externalities were identified. This is perfectly normal, as no project has only positive externalities.

In the following paragraphs we will analyze the two categories of externalities, including a presentation of how they are transformed from financial values into economic and social values.

Negative externalities:

The only **negative externality** of the analysis is the economic value of the **investment costs**, fiscally corrected according to the indicators presented at the end of this chapter. Basically, to obtain all the benefits that the project in question generates, investment costs are necessary, which can always be redirected to other strategic objectives. If from a financial point of view their impact has been calculated in the previous section, from an economic point of view they will be included in the next section, representing a negative element in the determination of performance indicators.

The following table shows the economic cost of investment costs, taking into account the conversion factor for the investment period.

		Scenario 1		**Scenario 2**	
Takeover financial part economically transposed	**U.M.**	**Year 1**	**Year 2**	**Year 1**	**Year 2**
Financial cost	You	40.292.766	11.022.442	43.979.277	11.901.292
Conversion factor	%	81,00%	81,00%	81,00%	81,00%
Economic cost of the proposed measures	You	32.637.140	8.928.178	35.623.215	9.640.046

Positive externalities

It represents all the elements that contribute in a positive way to the economic profitability of the project. In this case - two major socio-economic benefits have been identified:

- Positive cash flow - transformed into economic income;
- Reducing CO_2 emissions - as a result of renewable energy;

Cash flow

The realization of the project results in a positive cash flow, specific to both scenarios.

The following table shows (for the first year of operation) the transformation of financial cash flows into economic income. Recall that annually as the amount of revenue decreases, implicitly the cash flow also decreases.

	Financial cash flow (year 1)	EV Operational	Economic flow
Scenario 1	3.972.754	67,40%	2.677.636
Scenario 2	3.915.687	67,40%	2.639.173

Cash flows are those determined in the financial analysis - and which have been taken into account in the calculation of the project's financial indicators.

CO2 reduction

As a result of the implementation of the project, the infrastructure will realize green hydrogen, which will replace conventional gas, resulting in a reduction of CO2 emissions produced by a gas production facility.

In order to calculate the amount of CO2 saved, we will look at alternative uses

- The hydrogen produced in the plant is injected into the National Natural Gas Transportation System (SNT) administered by TRANSGAZ SA, to be mixed with natural gas and introduced into the economic circuit, to the final consumers (SME companies).

The basic assumption is that: **1.000 Nmc H2 displaces 1.000 Nmc methane gas**, equivalent to 668 kg methane gas under normal conditions of pressure (atmospheric) and temperature (20 degrees Celsius).

- Burning one kg of methane gas releases 2.75kg of CO2 into the atmosphere -> so by the assumed assumption, 1000 Nmc H2 prevents the release of 1,837kg of CO2 into the atmosphere. According to the estimate about 100 t H2 will be produced, equivalent to 1,112,600 Nmc H2, which ***will prevent 2043 t CO2 from being released into the atmosphere, equivalent to 102,150 mature trees, or about 200 hectares of forest***. For ease of calculation - the value will be rounded to 2100 tons CO2.

- Releasing 1 kg of methane gas into the atmosphere (through technological losses, including end-user losses, incomplete combustion, etc.), however, generates a much more detrimental effect on the environment, with a potential to generate a global warming effect (Global Warming Potential - GWP https://www.epa.gov/ghgemissions/understanding-global-warming-potentials) 25 times higher than CO2, thus being considered to generate an impact of *at least* 25kg CO2e (CO2 equivalent) -> thus, 1.000 Nmc H2 prevents a negative impact of 16,7t CO2e (CO2 equivalent).

According to the estimate, for the 100 t H2, equivalent to 1,112,600 Nmc H2, ***it will prevent a negative impact in the atmosphere of 18,580 t CO2e (CO2 equivalent), equivalent to 929,000 mature trees, or about 1800 hectares of forest***. For ease of calculation - the value will be rounded to 18,500 tons CO2.

Thus, for the first 10 years of operation, both scenarios will generate a CO2 emission reduction of 18,500 tons. Over the next 10 years, the reduction in these emissions will decrease in proportion to the reduction in green hydrogen production.

	Scenario 1	Scenario 2
Green hydrogen	107,856	107,856
Tone CO2 reduced	18.500	18.500

According to https://tradingeconomics.com/commodity/carbon, the average price of a CO2 certificate has now reached **over €90/tonne** of CO2. At the same time, forecasts indicate an average price of more than **70 €/tonne for the next 2 years**, other estimates are not available at this stage. It is therefore considered that, from a financial point of view, each ton of CO2 saved as a result of the implementation of the project has the value of a green certificate - which is why we will consider a value of 85 euros as a benchmark for the economic analysis of the project. (418 lei). A precautionary reserve has therefore also been taken into account, the economic benefits being slightly underestimated in correlation with the precautionary principle.

Financial value	Conversion factor	Economic value
418	67,4%	281,84

The following table shows the economic revenues related to CO2 reduction for the two scenarios analyzed, valid for the first 10 years of operation. Details on the evolution of the CO2 emissions saved can be found in Table 10 in the appendices containing the tables of the analysis.

	Tone CO2 reduced	Economic revenue tonne	Annual economic income
Scenario 1	390.195	226,57	88.406.481
Scenario 2	390.195	226,57	88.406.481

Verification of the economic viability of the project

The calculation formulas for determining the two indicators are similar as for the financial indicators, the only difference being that they are applied to the economic values determined in the previous paragraphs. Also, the discount rate (i) in this case is 5%.

The following formula is used to calculate the net present value (FNPV in the following image).

$$\text{FNPV} = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \dots + \frac{S_n}{(1+i)^n}$$

For the calculation of the Internal Economic Rate of Return of the project. (FRR)

$$0 = \sum \frac{St}{(1+FRR)^t}$$

Total economic costs/ Total economic revenue for cost/benefit calculation

The results of the economic and social analysis are presented in the following table. The economic indicators show that the investment project has a high economic profitability and the benefit-cost ratio is above unit cost, the benefits clearly outweighing the costs.

	Scenario 1	Scenario 2
RIR/E	**22,56%**	**20,73%**
NPV/E	**83.059.791,04**	**79.135.452,80**

Indirect benefits are benefits that do not directly influence infrastructure users, but have a wider impact through the social and economic opportunities that the establishment of infrastructure creates. Examples of indirect benefits:

- Increase energy efficiency by reducing consumption of natural resources;
- Increased quality of life;
- Reducing greenhouse gases;
- Prevent and combat pollution;

In conclusion, from the point of view of quantitative indicators (RIR/E respectively NPV/E), the chosen scenario **is scenario number 1**, which is more beneficial from an economic and social point of view compared to scenario 2. In terms of qualitative benefits (as described above), both scenarios are similar and have the same impact.

4.8. Sensitivity analysis

Sensitivity analysis aims to identify critical variables and the potential impact of changes in these variables on financial and economic performance indicators.

This analysis, which involves the following steps, is presented below:

- identifying **the variables** that are considered **critical** for the sustainability of the project benefits. This will be accomplished by percentage modifying a set of investment variables and then calculating the value of financial performance indicators;
- identifying the performance indicators for which variable may become critical;
- the calculation of the "switching values" for the identified critical variables (represents the percentage change of the identified critical variable that causes the value of the analyzed performance indicator to fall below a minimum acceptable level).

Thus, we start the sensitivity analysis by establishing the input parameters on which it will be structured. These parameters will represent the critical variables in this study. Their variation will determine variations in the performance indicator of the project. Depending on the propagated effects, the critical variables will be classified into elastic, inelastic or unit elasticity. The sensitivity analysis will form the basis of the risk analysis in the next subchapter.

The input parameter that represents the critical variable is the **investment value of the project** whose value is presented in the following table.

Critical variable - Scenario 1	Critical variable - Scenario 2
▪ **Project investment value -**	▪ **Project investment value**
51.315.207	55.880.569

The performance indicators for which the calculation of the switching values will be realized is one of the most representative indicators of the project, namely:

- Economic Net Present Value (NPV);

In the following we will analyze the impact of the variation of the input variables on the project performance indicator. The impact will be identified by separate measurements for 1%, 5% and 10% variations of the parameter (considered to be the critical variable) and then, if it is found to be a critical variable, the switching threshold and the elasticity curve will be determined.

Economic Net Present Value (NPV) - scenario 1

It will vary the value of the investment by +1%, +5% and +10% respectively. The new performance indicators vary as follows:

Indicator	Calculator	-1%	-5%	-10%
Investment value	51.315.207	51.828.359	53.880.968	56.446.728
NPV/E	83.059.791	81.980.014	77.660.905	72.262.018
Elasticity indicator		1,30%	6,50%	13%

Economic Net Present Value (NPV) - scenario 2

It will vary the value of the investment by +1%, +5% and +10% respectively. The new performance indicators vary as follows:

Indicator	Calculator	-1%	-5%	-10%
Investment value	55.880.569	56.439.375	58.674.598	61.468.626
NPV/E	79.135.453	78.106.692	73.991.648	68.847.844
Elasticity indicator		1,34%	6,70% %	13,40%

It can be seen that in the present case we are dealing with elastic NPV/E with an elasticity of 1.3% in scenario 1 and 1.34 in scenario 2. However reported, the value of investment is not a critical variable, the variation being below 5%/ commuted percentage point, the minimum threshold for defining critical variables.

Quantitative risk analysis is required only for critical indicators that have an elasticity of more than 5%, which is not the case here. In the following chapter, the risk analysis is presented only at the qualitative level, presenting the main risks and the measures to prevent and mitigate them.

4.9. Risk analysis, risk prevention/mitigation measures

In view of the results of the sensitivity analysis and taking into account the uncertainties related to issues not directly reflected in the calculations made in the cost-benefit analysis, a risk matrix was prepared in order to identify risk prevention and mitigation measures. This matrix is generally valid for both scenarios analyzed.

A Probability of Occurrence (P) is assigned to each adverse event. Below, a recommended classification provided in the "Guide for Cost-Benefit Analysis of Investment Projects. Economic Evaluation Tool for Cohesion Policy 2014-2020":

- A: Very unlikely (probability 0-10 %)
- B: Unlikely (probability 10-33 %)
- C: Medium probability (33-66% probability)
- D: Probable (66-90% probability)
- E: Very likely (90-100 % probability)

Each effect is assigned an impact (S) ranging from, say, I (no effect) to VI (catastrophic), based on the cost and/or loss of social welfare generated by the project. These numbers allow a ranking of risks, associated with their probability of occurrence. Below is the classification recommended in the "Guidelines for Cost-Benefit Analysis of Investment Projects. Economic Evaluation Tool for Cohesion Policy 2014-2020".

Ranking risk by impact

Classification	Meaning
I	No significant effect on social welfare even without remedial measures
II	Insignificant reduction in social welfare generated by the project, affecting very little the long-term effects of the project. However, remedial or corrective measures are needed.
III	Moderate: reduction in social welfare generated by the project, mostly of a financial nature, even in the medium-long term. Remedial measures could correct the problem.
IV	Critical: Significant reduction in social welfare generated by the project; the occurrence of the risk causes a loss of the primary function(s) of the project.

	Remedial measures, even on a large scale, are not sufficient to avoid serious damage.
V	Catastrophic: Project failure may lead to serious or total loss of project functions. The main medium-long term effects of the project do not materialize.

The risk level is the combination of Probability and Impact (P*S).

Risk levels considering impact and likelihood - general

Impact / Probability	I	II	III	IV	V
A	Low	Low	Low	Low	Moderated
B	Low	Low	Moderated	Moderated	High
C	Low	Moderated	Moderated	High	High
D	Low	Moderated	High	Very Ridiculous	Very Ridiculous
E	Moderated	High	Very Ridiculous	Very Ridiculous	Very Ridiculous

Risk prevention matrix

Risk description	**Probability (P)**	**Severity (S)**	**Risk level (=PxS)**	**Risk prevention/ risk mitigation measures**	**Residual risk after prevention/mitigation measures**
Exceeding investment costs	C	III	Moderated	The investment costs estimated at the design - feasibility study phase are based on market prices for the year in which the feasibility study was conducted. Extra attention to budget building, extra checking of bids.	Redus
Project delays due to administrative procedures	B	II	Redus	The project implementation team will liaise with the funding authority to unblock situations that arise.	Redus
Incorrect assessment of investment value and operating costs	C	III	Moderated	Consultation with experts and/or suppliers in the field for investment planning.	Redus

Risk description	Probability (P)	Severity (S)	Risk level (=PxS)	Risk prevention/ risk mitigation measures	Residual risk after prevention/mitigation measures
Risk of abandonment of work by the constructor	B	II	Redus	Properly drafted contractual clauses.	Redus
The risk of not respecting the implementation timetable	C	III	Moderated	Application of the provisions of the contracts concluded by the Beneficiary with the contractors. Properly drafted contractual clauses.	Redus
Contractor risks (bankruptcy, lack of resources)	B	II	Redus	Application of the provisions of the contracts concluded by the Beneficiary with the contractors. Monitoring that the resources specified in the Contractor's bid are allocated to the Contractor's implementation of the contract.	Redus
Unexpected political or regulatory factors affecting energy prices	D	III	Moderated	Frequent and continuous information on possible new regulations in areas applicable to the project. Regular monitoring of proposals to amend the legislative/regulatory framework with impact on the energy sector.	Redus
Expected price developments for key project inputs are incorrect	B	III	Redus	Application of the principle of prudence in determining both costs and income. Keeping the assumptions correlated so that the fall in revenues would also lead to a fall in costs, the impact on cash flow would be minimal.	Redus

The risk analysis shows that the residual risks for the project are reduced as a result of the measures foreseen to prevent the occurrence of the identified risks and/or mitigate their impact should they materialize. The overall level of residual risk is considered to be acceptable. Therefore, it can be concluded that the likelihood of the project not achieving its objectives is marginal, taking into account that the mitigation/prevention measures in the above matrix are properly implemented.

5. Recommended optimal techno-economic scenario/option(s)

5.1. Comparison of the proposed scenarios/options from a technical, economic, financial, sustainability, sustainability and risk point of view

Scenarios comparison
Options analysis - financial

	SCENARIO 1	SCENARIO2
Investment value	51.315.207,43	55.880.569,20
Number of electrolyzers	2	5
Electrolyzer power (electric)	2.5MW /buc	1MW/buc
RIRF/C	3,37%	2,29%
RIRF/K	18,28%	16,86%
RIRF/E	22,56%	20,73%
SUSTAINABILITY	YES - ALL YEARS	YES - ALL YEARS
RECOVERY TIME (YEARS)	5	11
PROFITABILITY	61,18%	59,2%
SENSITIVITY	ELASTIC	ELASTIC

SCENARIO 1

Advantages of scenario 1:

- Shorter execution time
- financial indicators
- Higher productivity
- Higher investment value

Disadvantages of scenario 1:

- In case of electrolyzer failure - losses are much higher.
- Longer delivery time

SCENARIO 2

Advantages of scenario 2:

- Fast delivery
- Fast replacement in case of defect

Disadvantages of scenario 2:

- Longer lead time
- Weaker financial indicators
- Lower productivity

5.2. Select and justify the optimal recommended scenario/option(s)

Scenario 1 is considered optimal to be implemented from an economic and financial point of view. The sensitivity analysis reveals the same aspect, by the fact that Scenario 1 remained the most attractive, in all the situations of variability analyzed.

Scenario 1 consists of the development of a green hydrogen production capacity consisting of two electrolyzers with an output of 2.5 MW/kWh. The exhaustive technical description of the technical solution has been carried out in Chapter 3.2.1.

5.3. Description of the recommended optimal scenario(s)/option(s) on:

d) land acquisition and development; - not applicable

b) providing the utilities necessary for the operation of the objective;

The land is located within the urban area of the administrative-territorial unit and benefits from the existing utilities in the area.

For the functionality of the objective it is necessary that the objective is connected to the electricity grid.

c) the technical solution, including the technological, constructional, technical, functional-architectural and economic description of the main works for the basic investment, correlated with the qualitative, technical and performance level resulting from the proposed technical-economic indicators;

The optimal technical solution recommended for the investment is realized with the following components:

a. Container

Electrolyzer containers have the following components:

- Insulated walls and ceilings.
- Floor made of tin.
- Lockable doors in exterior walls.
- Lighting in all sections.
- All equipment fully deployed and installed with piping and cabling, reducing on-site installation/assembly time and costs.
- Forced heating and ventilation (in Zone 2: ATEX Directive 2014/34/EU)
- Safety seal on container roof
- Emergency lights or emergency lights for at least 30 minutes in the event of a power cut
- Outdoor lighting system
- Lights outside the container at the entrance to the control/utility room and process room
- Exhaust lines: Two stainless steel tubes with rain caps for safe venting of H_2 and O_2.
- Heaters to protect equipment from sub-zero temperatures.

b. Electrolysis module

The central component of the hydrogen generation part of the process is the PEM (Polymer Electrolyte Membrane Membrane Stack) electrolysis stack. The cell stack consists of electrolyte cells, each containing a MEA 'membrane electrode assembly', two GDL 'gas diffusion layers' and a bipolar plate.

H_2 and $O_2$are generated when process/cooling water is fed into the equipment and charged with electricity. Further in the process the gases are directed to the dryer, where the gases are cooled and the water is condensed.

c. Hydrogen purification

The hydrogen purification system is designed to further purify hydrogen to a minimum of 99.999%. This purity is achieved in two stages:

- Deoxo stage: reduction of O2 to H2 by catalytic reaction;
- Drying stage: for moisture reduction in 2 absorption tanks: one in operation and one in standby/regeneration mode.

d. Water treatment

Demineralized water is circulated through the cell stack of the PEM 1500E at a high flow rate. A small part of the water is split into H2 and O2, while most of it is used to dissipate the heat and gases produced. Fresh demineralized water is continuously supplied to balance the water converted into H2 and O2. This pure water is produced in skid drinking water treatment. This drinking water treatment pumps demineralized water into a buffer tank. From there, the treated water is fed into the electrolysis process cycle through the injection pump if necessary. There is continuous monitoring of the water quality in the pressurized electrolysis circuit, resulting in a regulated bypass circulation through the internal water treatment system.

e. Utilities

The utility room is a separate room in the container to house other necessary peripherals and the operating system. The gas cooler is installed outside the container. The picture below also shows a catch tank to collect the coolant of the closed cooling circuit in case of a valve failure.

f. Measurement and taxation set point

The Measurement and Control Regulation Point (MCRP) is used to collect the hydrogen produced, reduce or regulate the hydrogen pressure within the operating range of the electrolyzers and to measure the amount of hydrogen produced and delivered to the NTS. The PRMF is containerized.

d) technological samples and tests.

Technological tests and specific tests will be carried out on the installations designed in accordance with the Technical Data Sheets of the equipment and the technical standards in force.

5.4. Main technical-economic indicators related to the investment objective:

a)maximum indicators, i.e. the total value of the investment object, expressed in lei, with VAT and without VAT, respectively, of which construction-assembly (C+M), in accordance with the general estimate;
(b) minimum indicators, i.e. performance indicators - physical elements/physical capacities indicating the achievement of the investment objective target - and, where appropriate, qualitative indicators, in accordance with the standards, norms and technical regulations in force;

The installation consists of the following equipment:

a. Container - 2 pcs
b. Electrolysis module - 1 pc
c. Hydrogen purification system - 1 pc
d. Water treatment system - 1 pc
e. Operating room - 1 pc
f. Control and taxation point - 1 pc

Indicator analyzed (UM)	Scenario 1
Amount of hydrogen	107.85 to/year
Amount of CO2	18.500 to

c) financial, socio-economic, impact, result/operational, impact, result/operational indicators, established according to the specificity and target of each investment objective;
This is not the case.

(d) the estimated duration of implementation of the investment objective, expressed in months.
The estimated duration of the investment objective, expressed in months**,** will be 24.

During the 24 months of execution of the proposed investment, the following stages will be completed:

The project involves 3 types of activities:
I. Project development activities:
1. Obtaining approvals and agreements, as appropriate; this activity will be carried out prior to the signing of the grant contract, being the only one of its kind.
2. Mandatory information and publicity activities;
3. Mandatory audit activities

4. Design and engineering

II. Construction/assembly activities:
1. Purchase and installation

III. Commissioning:
1. Reception and commissioning of the production installation
2. Reception and commissioning of the connection installation

5.5. Presentation of how compliance with the regulations specific to the intended function is ensured in terms of meeting all the fundamental requirements applicable to the construction, according to the level of detail of the technical proposals

Compliance with the specific regulations in force is done in compliance with Law 50/1991 with subsequent amendments and additions, on the authorization of the execution of construction works, procedures for the acceptance upon completion of works, acceptance upon commissioning and final acceptance.

In order to obtain the Building Authorization the beneficiary must obtain at least the following documents:

1. Environmental agreement from the Environmental Protection Agency
2. Water supply notice
3. Electricity supply notice
4. Sanitation notice
5. Neighbors agreement
6. Fire safety advisory
7. Civil protection notice
8. Population health notice
9. Topographical plan endorsed by OCPI
10. Geotechnical study - checked for Af requirement.
11. Authorization fee

The realization of the installation must ensure that the following requirements and needs are met:

- Improving energy efficiency and harnessing renewable energy resources to reduce climate change impacts for the SME sector
- Reducing electricity consumption, thus cutting costs;
- Significant reduction in maintenance/maintenance costs;
- Fully safe and economically efficient operation and use of infrastructure;
- Improving safety standards;

- Meeting standardized objectives;
- Raise civilization, comfort and quality of life;
- Improved environmental conditions by reducing CO2 emissions from the new technology.
- To achieve an optimal quality/cost ratio for the period of the cooperation contract and a balance between the risks and benefits assumed by the contract (the structure and level of the tariffs charged will reflect the actual cost of the service and will be in accordance with the legal provisions);
- Support and stimulate the economic and social development of the SME sector;
- The safe, cost-effective and economically efficient operation and exploitation of the infrastructure related to the service.

5.6. Nomination of the sources of financing of the investment, as a result of the financial and economic analysis: own funds, bank loans, allocations from the state budget/local budget, external loans guaranteed or contracted by the state, non-reimbursable external funds, other legally established sources.

The sources of financing for investments are established in accordance with the legislation in force and consist of own funds, bank loans, funds from the state budget/local budget, external loans guaranteed or contracted by the state, non-reimbursable external funds and other legally established sources.

The co-financing of the project will be from the beneficiary's own sources.

No. Crt.	Sources of funding	Value
I	Total investment (I=II+III)	**60.931.423,60**
	of which VAT	**9.616.216,18**
II	Ineligible investment	**8.907.655,11**
III	Eligible amount of investment	**42.407.552,32**
1	Amount of state aid applied for	**33.944.550,00**

6. Urban planning, agreements and compliant opinions

6.1. Urban planning certificate issued in order to obtain the building authorization -

For the proposed investment will be obtained Urban Planning Certificate issued by UAT.

6.2. Extract from the land register, except in special cases expressly provided by law - not applicable
6.3. Administrative act of the competent authority for environmental protection, mitigation measures, compensation measures, how the provisions of the environmental agreement are integrated into the technical-economic documentation - not applicable

6.4. Assent on the provision of utilities -
Electricity supply contract
Water is provided from the beneficiary's own facilities - wells drilled on site.
In order to obtain the building permit, several approvals will be required by the urban planning certificate:

1. Environmental agreement from the Environmental Protection Agency
2. Water supply notice
3. Electricity supply notice
4. Notice National Natural Gas Transportation Company Transgaz SA
5. Population health advisory

6.5. Topographical survey, endorsed by the Cadastre and Real Estate Publicity Office - not applicable

6.6. Approvals, agreements and specific studies, as appropriate, depending on the specifics of the investment objective and which may condition the technical solutions - after commissioning, the issuance of the Authorization for Establishment will be requested for new hydrogen production plants based on ANRE Order 200/28.10.2020.

7. Investment implementation

7.1. Information about the entity responsible for implementing the investment

The main identification data of the Beneficiary, which will be responsible for the implementation of the investment are the following:

- ✓ CAEN Code: 2011 - Manufacture of industrial gases
- ✓ Form of organization: SRL or SA

7.2. Implementation strategy, including: duration of implementation of the investment objective (in calendar months), duration of execution, investment implementation schedule, investment phasing over the years, resources required

As mentioned above, the overall objective is to address the main challenges of the SME sector in Romania in terms of decarbonization and air pollution, i.e. ensuring the green transition of the

.

SME sector by promoting renewable electricity generation, energy efficiency and future technologies.

The project involves the realization of 3 types of activities, carried out over 24 months of project implementation, as follows:

I. Project development activities:

1. Obtaining the technical opinion of connection, permits and agreements, as appropriate; this activity will be carried out prior to the signing of the financing contract, being the only one of its kind.
2. Mandatory information and publicity activities;
3. Mandatory audit activities
4. System design and engineering

II. Construction/assembly activities:

1. System purchase and installation

III. Commissioning:

1. Reception and commissioning of the utilization installation
2. Reception and commissioning of the connection installation

In terms of investment components they focus on 3 main directions:

- Procurement of construction and installations and machinery, technological and functional equipment and equipment requiring assembly, in the amount of 45.699.517,74 lei excluding VAT, consisting of:
- Mandatory information and publicity services, amounting to 5.000 lei excluding VAT;
- Mandatory audit services, amounting to 12.298 lei excluding VAT.

The phasing of the investment by years and sources of funding will be as follows:

THE DEFERRAL OF THE INVESTMENT				
Nr.crt.	**Stages in the realization of the investment**	**AN 1- Without VAT**	**Year 2 without VAT**	**Total without VAT**
1	**2**			**4,00**
1	Getting the land	1.287.000,00	-	1.287.000,00
2	Land development	-	284.865,92	284.865,92
3	Connections	512.258,30	963.591,70	1.475.850,00
4	Field studies	52.500,00	-	52.500,00
5	Supporting documentation and costs for obtaining permits, agreements and authorizations	238.890,92	-	238.890,92

6	Technical expertise	10.000,00	-	10.000,00
7	Design theme	5.000,00	-	5.000,00
8	Feasibility study	49.195,00	-	49.195,00
9	DTAC	12.298,00	-	12.298,00
10	Check	22.137,00	-	22.137,00
11	Technical project	270.572,50	-	270.572,50
12	Consulting services	303.237,50	303.237,50	606.475,00
13	Financial audit	-	12.298,00	12.298,00
14	Technical assistance	50.312,73	60.375,27	110.688,00
15	Site management	37.566,82	45.080,18	82.647,00
16	Construction and installation	2.630.743,55	229.908,77	2.860.652,32
17	Assembly of machinery, technological and functional equipment	2.633.572,34	658.393,08	3.291.965,42
18	Machinery, functional technological equipment requiring assembly	31.600.800,00	7.900.200,00	39.501.000,00
19	Machinery, technological and functional equipment not requiring assembly and transportation equipment	36.720,00	9.180,00	45.900,00
20	Construction and installation works related to site organization	257.400,00	-	257.400,00
21	Expenses related to the organization of the site	15.000,00	-	15.000,00
22	Fees, rates, charges, cost of credit	234.514,45	469.028,90	703.543,35
23	Miscellaneous and unexpected expenses	30.546,75	10.182,25	40.729,00
24	Expenditure on information and publicity	2.500,00	2.500,00	5.000,00
25	Operational staff training	-	14.200,00	14.200,00
26	Technological tests and trials	-	59.400,00	59.400,00
Total (excluding VAT)		**40.292.765,85**	**11.022.441,57**	**51.315.207,43**
of which C+M		**8.170.733,66**	**1.552.439,40**	**9.723.173,06**
VAT		**7.611.067,77**	**2.005.148,41**	**9.616.216,18**
Total (including VAT)		**47.903.833,62**	**13.027.589,98**	**60.931.423,60**

Details of the sources of financing of the investment will be presented in accordance with the table:

No. Crt.	Sources of funding	Value
I	Total investment (I=II+III)	**60.931.423,60**
	of which VAT	**9.616.216,18**
II	Ineligible investment	**8.907.655,11**
III	Eligible amount of investment	**42.407.552,32**

1	Amount of state aid applied for	**33.944.550,00**

In order to ensure a successful implementation of the investment project, outsourced project management services have been foreseen. Collaboration with an experienced person from the consultant in project management services is expected, together with the technical manager.

7.3. Operation/operation and maintenance strategy: steps, methods and resources required

a) land acquisition and development; - not applicable

b) providing the utilities necessary for the operation of the objective;

For the functionality of the lens it is necessary that the lens is connected to the network. **c)** the technical solution, including the technological, constructional, technical, functional-architectural and economic description of the main works for the basic investment, correlated with the qualitative, technical and performance level resulting from the proposed technical-economic indicators;

The optimal technical solution recommended for the investment is realized with the following components:

Scenario 1 - 2.5 MW electrolyser

Electrolysis modules

To generate the desired quantity of approx. 1000 nmc/h of hydrogen, *the plant consists of two HyLYZER®-500 container modules*, each with a 2.5 MW PEM electrolyzer (installed electrical power).The PEM electrolyzers are modular, designed for easy transportation and installation, with excellent interconnectivity for scalability and unrivaled experience in terms of resilience, low maintenance and maximum operational safety.

Each of the 2 modules consists of the following main components.

g. Container

Electrolyzer containers have the following components:

- Insulated walls and ceilings.
- Floor made of tin.
- Lockable doors in exterior walls.
- Lighting in all sections.

- All equipment fully deployed and installed with piping and cabling, reducing on-site installation/assembly time and costs.
- Forced heating and ventilation (in Zone 2: ATEX Directive 2014/34/EU)
- Safety seal on container roof
- Emergency lights or emergency lights for at least 30 minutes in the event of a power cut
- Outdoor lighting system
- Lights outside the container at the entrance to the control/utility room and process room
- Exhaust lines: Two stainless steel tubes with rain caps for safe venting of H_2 and O_2.
- Heaters to protect equipment from sub-zero temperatures.

h. Electrolysis module

The central component of the hydrogen generation part of the process is the PEM (Polymer Electrolyte Membrane Membrane Stack) electrolysis stack. The cell stack consists of electrolyte cells, each containing a MEA 'membrane electrode assembly', two GDL 'gas diffusion layers' and a bipolar plate.

H_2 and $O_2$are generated when process/cooling water is fed into the equipment and charged with electricity. Further in the process the gases are directed to the dryer, where the gases are cooled and the water is condensed.

The unit consists mainly of:

- stainless steel frame
- 2x PEM 1500E holds
- Circulation pump for demineralized water
- Injection pump for demineralized water
- hydrogen gas separator
- oxygen gas separator
- Gas cooler for hydrogen "dehumidifier" - coalescing filter
- Heat exchanger for drinking water and gas cooling
- Atmospheric hydrogen leak detector (HTA)
- Oxygen content in the hydrogen produced (HTO)
- instrumentation, sensors, etc.
- closure fittings

- terminal boxes
- separate exhaust system (H_2 and O_2)

i. Hydrogen purification

The hydrogen purification system is designed to further purify hydrogen to a minimum of 99.999%. This purity is achieved in two stages:

- Deoxo stage: reduction of O2 to H2 by catalytic reaction;
- Drying stage: for moisture reduction in 2 absorption tanks: one in operation and one in standby/regeneration mode.

The unit consists mainly of:

- stainless steel frame
- Deoxo tank with catalyst to remove O2 from H2
- Deoxo tank heating and insulation
- heat exchanger
- coalescing filter
- Drainage system for water drainage
- Two absorption drying vessels filled with molecular sieve
- Electrical heating and insulation of the two absorption dryer tanks
- Connection pipes to the gas cooling circuit
- Connection lines to the exhaust system (H2 and O2)
- shut-off valves
- Online purity measurement (monitoring ppm O2 in H2 and ppm H2O in H2)
- automatic discharge of H2 to the atmosphere if its quality is out of specification.
- Automatic restart (PT-U)

j. Water treatment

Demineralized water is circulated through the cell stack of the PEM 1500E at a high flow rate. A small part of the water is split into H2 and O2, while most of it is used to dissipate the heat and gases produced. Fresh demineralized water is continuously supplied to balance the water converted into H2 and O2. This pure water is produced in skid drinking water treatment. This drinking water treatment pumps demineralized water into a buffer tank. From there, the treated water is fed into the electrolysis process cycle through the injection pump if necessary. There is continuous monitoring of the water quality in the pressurized electrolysis circuit, resulting in a regulated bypass circulation through the internal water treatment system.

The unit consists mainly of:

- stainless steel frame
- Gas separator H2 H2 tank drain
- Buffer tank 1 water circuit
- Buffer tank 2 water circuit
- Level monitoring on each tank
- water circulation pump
- filter
- Continuous water quality monitoring
- valve
- safety valves

k. <u>Utilities</u>

The utility room is a separate room in the container to house other necessary peripherals and the operating system. The gas cooler is installed outside the container. The picture below also shows a catch tank to collect the coolant of the closed cooling circuit in case of a valve failure.

The unit consists mainly of:

➢ Separate, lockable entrance door
➢ Thermally insulated walls
➢ HVAC system
➢ Water purification system
➢ Closed-loop cooling water pump

- Cooling water thermostat control
- cooler (outside)
- switch panel

l. Measurement and taxation set point

The Measurement and Control Regulation Point (MCRP) is used to collect the hydrogen produced, reduce or regulate the hydrogen pressure within the operating range of the electrolyzers and to measure the amount of hydrogen produced and delivered to the NTS. The PRMF is containerized.

d) technological samples and tests.
Technological tests and specific tests will be carried out on the installations designed in accordance with the Technical Data Sheets of the equipment and the technical standards in force.

7.4. Recommendations on ensuring managerial and institutional capacity

Project management will be divided between a team of internal company employees and a consultancy firm (external team) that will provide support throughout the project implementation period. In order to ensure a successful implementation of the investment project, outsourced project management services have been foreseen. It is envisaged to work with one experienced person from the consultant in project management services, together with the technical manager.

The tasks of the external project management team are the following:

- It is responsible for the development of management plans for the successful implementation of project activities and achievement of planned project results;
- Supervise the day-to-day running of the project and manage the project team in order to achieve the set tasks in line with the proposed activities and deliverables;
- Is responsible for coordinating the day-to-day project management - organizational and conceptual;
- Provide advice to all members of the project team during the realization of the project activities in line with the project objectives;
- Monitor compliance with the provisions of the grant program during project implementation;
- Check the consistency of the project objectives with the fulfillment of the NRRP goals and objectives.;
- Verify and ensure the applicant's financial capacity to sustain the project after its completion, as well as the applicant's technical and human resources capacity.
- Preparing reimbursement claims;
- Follow-up of the implementation under the conditions set out in the project grant contract;
- Preparation of technical solution modifications according to the financing contract;

- Consultancy in drafting additional acts to supply contracts (service, goods);
- Advice in drafting responses to additional requests;
- Coordination of parties involved in the process of obtaining funding: suppliers of goods and services;
- Assistant in the relationship with the Managing Authority of the funding program.

The CVs of the project team members, together with the job descriptions, support the managerial capacity of the enterprise to successfully implement and operate the proposed project.

In addition to the project team, in order to implement the project successfully, the services of a specialized consultancy company will be called upon to assist both technically and in terms of project management.

8. Conclusions and recommendations

The implementation of the project at the level of different SME companies will bring a real benefit by ensuring energy sustainability in the SME sector, as well as by ensuring the green transition of the SME sector by promoting renewable electricity production, energy efficiency and future technologies, contributing to the achievement of the objectives assumed by Romania.

Although hydrogen from renewable sources is more expensive than the fossil fuel alternative, there are promising premises for reducing overall costs in the coming years, based on forecasts for a significant reduction in the investment cost of electrolysers (about 5 times by 2030 compared to 2023) and the cost of renewable energy, which has been steadily decreasing over the last decade, especially solar energy.

The recent energy crisis has demonstrated the volatility of gas prices, which can be induced by unforeseen geopolitical actions. Although the currently untapped gas reserves in Romania (Black Sea) create expectations of lower gas prices in the coming years, there is no clear/certain forecast about the impact on gas wholesale market prices. In addition, the use of fossil fuels will become increasingly costly in view of the expected increases in the price of carbon dioxide ($CO2$) as a result of the EU-ETS review. Current fossil fuel-based hydrogen production will thus have to be phased out.

Hydrogen can be used in different segments and helps to reduce carbon emissions in mobility applications, industrial production processes and residential applications for heating and power supply. This flexibility makes hydrogen the ideal fuel for climate neutral technologies. In addition, hydrogen can be used as an industrial feedstock to power fuel cells or in turbines and engines used in various SME sectors.