

Министерство на
иновациите и растежа

ВОДОРОДНО БЪДЕЩЕ ЗА БЪЛГАРИЯ



**НАЦИОНАЛНА ПЪТНА КАРТА ЗА
ПОДОБРЯВАНЕ НА УСЛОВИЯТА ЗА
РАЗГРЪЩАНЕ НА ПОТЕНЦИАЛА ЗА
РАЗВИТИЕ НА ВОДОРОДНИТЕ ТЕХНОЛОГИИ И
МЕХАНИЗМИТЕ ЗА ПРОИЗВОДСТВО И
ДОСТАВКА НА ВОДОРОД**

Content

ABBREVIATIONS USED.....	3
1. INTRODUCTION.....	4
2. VISION AND OBJECTIVES.....	5
3. IMPROVING THE CONDITIONS FOR DEVELOPING THE POTENTIAL OF HYDROGEN TECHNOLOGIES AND HYDROGEN PRODUCTION AND SUPPLY	9
4. REGULATORY FRAMEWORK, PROGRAM AND FINANCIAL INSTRUMENTS AT EUROPEAN AND NATIONAL LEVEL	26
5. MANAGEMENT AND MONITORING.....	39
6. IMPLEMENTATION PLAN.....	40

ABBREVIATIONS USED

GDP	Gross domestic product Bulgarian
BAN	Academy of Sciences Renewable
VI	sources Hydrogen charging
VZS	station Important projects of
VPOEI/ IPCEI GP	common European interest Guarantees of origin
EU	European Union
EC	
	European Commission
EU ETS	EU Emissions Trading System Energy System
	Operator European Alliance for
EERA	Energy Research
ECH2A	European Clean Hydrogen Alliance Fuel Cell
EPSGK	Electric Vehicle
EIZ	European Economic Area European
ESIF	Structural and Investment Funds Charging station
ZS	
ZE	Energy Act Renewable
ZEVI	Energy Act Economic Commission for Europe
IKE	
ISIS	Innovation Strategy for Smart Specialization 2021-2027
IPEC	Integrated plan in the field of energy and climate of the Republic of Bulgaria
IUPR	Institute for Sustainable Transition and Development
KSEZS	Advisory Council on the European Green Deal
KEVR	Energy and Water Regulatory Commission
KIKI	Commission for the Development and Implementation of Innovations and the Circular and Bio-Based Economy
SME	Small and Medium Enterprises
ME	Ministry of Energy Ministry of Innovation
MIR	and Growth
MS	Council of Ministers
MSE	Connecting Europe Facility
NIF	National Innovation Fund Research and
NIRD	Development
NPVU	National Plan for Recovery and Sustainability National
NPR BULGARIA 2030	Development Program BULGARIA 2030
NSSRB	National Association of Municipalities in Bulgaria
UN	United Nations
PCIP	Enterprise Competitiveness Program 2021-2027 and innovations in
PNIIDITE	Program "Research, Innovation and Digitization for Smart Transformation" 2021-2027.
PETE	Economic Transformation Program
POI	Projects of general interest
SP GKV	Fuel Cells and Hydrogen Joint Undertaking
SP	Clean Hydrogen Joint Venture
CHV STE	Emissions Trading Scheme
SET	Europe's Energy Technology Strategic Plan
TPSP	Territorial plans for a just transition
FNI	Research Fund

FSP	Just Transition Fund
FNF	Fund of Funds
CPO	Professional training centers
SDG	UN Sustainable Development Goals
R&I	Scientific research and innovation

1. INTRODUCTION

The introduction of hydrogen technologies into the European economy has been identified as a key factor in meeting the ambitious goals of **the European Green Deal**, enshrined in **the European Climate Law**: reducing net greenhouse gas emissions by 2030 by at least 55% compared to levels since 1990 and achieving net-zero emissions by 2050 in the European Union (EU).¹ To achieve these goals, the "Hydrogen Strategy for a Climate-Neutral Europe" sets out a large-scale transformation in all sectors of the economy based on the production and consumption of hydrogen.

2

This document was followed by the development of national hydrogen strategies in almost all Member States and their expansion on a global scale, making hydrogen technologies a leading factor in the decarbonisation of industry, transport, the energy sector and the transition to a hydrogen economy.

Hydrogen can be used as a feedstock, fuel or energy carrier and energy storage medium and has many possible applications in industry, transport, power and heating. It is an important raw material for a number of key industries such as the production of methanol, ammonia and nitrogen fertilizers, as well as conventional fuels for transport. Hydrogen can offer solutions in the transport system to reduce harmful emissions.

The last two years have seen an emphasis on green hydrogen in European policies and funding programmes. Its leading advantage is the scale of its implementation, which has no limits and depends only on the amount of renewable energy produced; it can be used to store energy from renewable energy sources, being one of the few technologies enabling seasonal energy storage. Most importantly, its use produces no CO₂ and almost no air pollution. In this way, green hydrogen offers a solution for the decarbonization of industrial processes and economic sectors in which the reduction of carbon emissions is difficult to achieve, but at the same time - necessary. All this makes hydrogen very important for the fulfillment of the EU's commitment to achieve carbon neutrality by 2050 and for global efforts to meet the goals of the Paris Agreement³.

Need for a national road map

The potential of hydrogen technologies and measures for decarbonization through the production and consumption of pure hydrogen still occupy a modest place in the existing national strategic documents, both in Bulgaria and in other member states. Among the reasons are the lack of accumulated data and analyzes for the last decade, accompanying the gradual development in this sector, as well as the ongoing complex work at the European level regarding the regulatory environment. A national road map is needed to create increased awareness, set expectations for sector development and chart a path for

¹ https://climate.ec.europa.eu/eu-action/european-green-deal/european-climate-law_bg

² <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:52020DC0301&from=BG>

³ <https://eur-lex.europa.eu/content/paris-agreement/paris-agreement.html?locale=bg>

phased entry and application of hydrogen technologies and use of hydrogen in Bulgaria.

The development of the Hydrogen Roadmap is set as a reform in the National Recovery and Sustainability Plan (NRSP)⁴. The reform is a key prerequisite for fulfilling the objectives of the Green Deal⁵ and the decarbonisation of the economy, given the potential of hydrogen to replace fossil energy sources in the economy of the future.

An important functionality of this document is that it will remain open for periodic updating given the dynamics in the sector and the need for continuous and step-by-step improvement of the regulatory framework, as well as the creation of a regulatory base where it is lacking.

The activities in the current Roadmap cover the period 2023-2026, as the first stage of a long-term policy to promote the hydrogen economy with a horizon over the next ten years.

2. VISION AND GOALS

The National Roadmap was developed in accordance with the Sustainable Development Goals (SDGs) of the United Nations, the priorities of the European Commission (EC) for the period 2019-2024: The European Green Deal and its implementation plans, the Fit for 55 Package, REPower EU, the Strategic Research and Innovation Agenda (SRIA)

⁶, The Framework Program for Scientific Research and Innovation of the EC "Horizon Europe", the Hydrogen Strategy for a Climate Neutral Europe as well as the Paris Agreement signed by Bulgaria to limit global warming to less than 2 degrees Celsius by 2050 compared to the period before industrialization, which put Bulgaria as an EU member state on the path to climate neutrality with a horizon of 2050. This document was also developed in accordance with the National Development Program BULGARIA 2030 (NPR BULGARIA 2030), the Long-Term Strategy for the mitigation of climate change until 2050 of the Republic of Bulgaria, the Integrated Plan in the field of energy and climate of the Republic of Bulgaria/IPEC (forthcoming update in June 2023), the Strategy for transition to a circular economy of the Republic of Bulgaria for the period 2022 - 2027, the Strategic Vision for the Electricity Sector of the Republic of Bulgaria 2023-2053, the Innovation Strategy for Intelligent Specialization (ISIS) 2021-2027 and will assist in the implementation of strategic reforms and investments laid down in the NPVU and the realization of the Territorial just transition plans (JTP) and other programs under the Partnership Agreement.

⁹,

European goals and their national dimension

The development of a National Road Map for improving the conditions for deploying the potential for the development of hydrogen technologies and the mechanisms for the production and supply of hydrogen in the Bulgarian economy follows the latest and ambitious plan of the EU for the Implementation of the Green Pact for a decarbonized and

⁴ <https://www.nextgeneration.bg/14>

⁵ https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0017.02/DOC_1&format=PDF

⁶ [SRIA_green_hydrogen.html \(bmbf.de\)](https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:52020DC0301&from=BG)

⁷ <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:52020DC0301&from=BG>

⁸ <https://www.minfin.bg/bg/1394>

⁹ [isis-2021-2027.pdf \(government.bg\)](https://www.minfin.bg/bg/1394)

energy independent Europe - REPowerEU. The implementation of the pan-European plan to achieve climate neutrality is determined by national reforms and investments of the member countries, including and Bulgaria. According to the recommendations of the EC to the NPVU, new actions should be foreseen to achieve the objectives of REPowerEU. In this regard, the National Roadmap will contribute to this update as much as possible, so that hydrogen technologies can take their rightful place for the decarbonization of the economy.

REPowerEU builds on the overall implementation of the 'Ready for Target 55' package of proposals, offering an additional set of actions which, in relation to clean hydrogen, are concentrated in the so-called "Hydrogen accelerator", where specific goals are defined and activities for their implementation are indicated, in which it is appropriate for Bulgaria to actively join:

- A new ambitious target of 10 million tons of domestic hydrogen production, from renewable sources, has been set, almost double the target set in "Prepared for Target 55" (5.6 million tons), which requires the production and operation of electrolyzers with a total capacity of about 130 GW on EU territory. That defines

and a need for the planning of national investment incentives related to the updating of national goals in terms of incentives related to promoting the production of electrolyzers and fuel cells, as well as scaling up the production of green hydrogen to modernize industrial sectors (such as ammonia production) and transport;

- The sub-goals regarding renewable fuels of non-biological origin are to be updated, incl. green hydrogen, as a result of analyzes and evaluations planned in the Roadmap (see section 6 "Implementation Plan"). This also determines an increase in ambitions regarding the introduction of hydrogen mobility (electric vehicles with a fuel cell), which has not yet been included in national strategies and programs;

- Create several Hydrogen Valleys in each EU Member State by 2025. 10 Hydrogen Valleys, co-financed through the Clean Hydrogen Joint Undertaking of the Horizon Europe Framework Program for Research and Innovation, are local ecosystems that link production, transport and the consumption of hydrogen by end users such as electromobility or industry. Bulgaria has already won its first Hydrogen Valley project in Stara Zagora, but the number of hydrogen valleys must increase, as well as their connectivity in hydrogen corridors at the transnational level;

- In solidarity, joint international activity will focus on establishing long-term framework collaborations with trusted partners through binding or other agreements that support the purchase and export of green hydrogen to EU Member States, while making full use of the Union's collective potential. Bulgaria should actively enter into these collaborations, taking into account the excellent conditions for the production of

green hydrogen, enabling both to cover national consumption, as well as for export to other member states;

- Acceleration of the evaluation of the first important projects of common European interest (IPCEI/VPOEI) in the field of hydrogen is requested. In September 2022, the first financial framework was also announced. Bulgaria did not manage to enter the initiative, but it is expedient to identify hydrogen projects of national interest, with a view to participation in subsequent stages;

- Another major goal of the Union is the creation of an infrastructure for the transfer and storage of produced hydrogen. The plan identifies three corridors: Mediterranean, across the North Sea and Southeast. In 2023, a preliminary map of hydrogen transport infrastructure needs will be prepared based on the TEN-E Regulation with the participation of Member States, national regulatory authorities, ACER, ENTSO, project coordinators and other stakeholders. It is extremely important for Bulgaria to take an active part in the development of the third corridor, which will realize the opportunities for exporting hydrogen;

¹⁰ [H2Valleys | Mission Innovation Hydrogen Valley Platform](#)

- Skills building is encouraged through the Erasmus+ program and the Clean Hydrogen Joint Undertaking. It is important for Bulgaria, after a good start with participation in the first projects, to strengthen its participation in European initiatives for the development of skills in the hydrogen technology sector;

- The creation of a new European hydrogen bank is proposed, the purpose of which is to act as an intermediary in the hydrogen market to overcome the lack of investment and achieve a match between supply and demand^{11,12}. The Bank should help ensure the purchase of hydrogen, using the €3 billion Innovation Fund to help build the future hydrogen market¹³;

- The revision of the Renewable Energy Directive (REDII) will accelerate the use of energy from renewable sources, including renewable gases such as hydrogen in the energy system. The proposed amendment increases the target for renewables in the EU's energy mix to 45%, with EC industrial hydrogen sub-targets of 50% by 2030 and 70% by 2035, and a non-biological renewable fuels sub-target of

transport of 5.7% and a sub-target of 1.2% for water transport by 2030. At the moment, the EU position is for 40% RES, for 35% hydrogen for industry and 5.2% for the transport sector.

- Internationally, ambitions and competitiveness in the sector are also increasing, especially since the United States of America approved the so-called Inflation Reduction Act¹⁴, which will implement the largest ever tax and investment incentives for energy-efficient technologies, including green hydrogen. This makes it even more urgent for Bulgaria to have a clear ambitious plan to promote hydrogen production as part of the country's energy mix and to use international networks and partnerships to stimulate the development of research, innovation and technology in the sector and the creation of new jobs.

VISION

Bulgaria will promote the development and use of hydrogen technologies to achieve progress in the implementation of climate goals, the reduction of greenhouse gas emissions, the stimulation of the transition to a higher and efficient use of renewable energy sources and to a circular economy.

A national road map for improving the conditions for deploying the potential for the development of hydrogen technologies and the mechanisms for the production and supply of hydrogen takes into account the specifics of the Bulgarian economy for the realization of a balanced and fair transition. The transformation towards climate neutrality is a dynamic and complex process, therefore our country must use the best practices for the benefit and support of the Bulgarian society and economy.

STRATEGIC GOALS

1. Using hydrogen to decarbonize the economy and for an alternative of other energy sources;
2. Creating the capacity to use the potential of hydrogen technologies.

¹¹ <https://eit-hei.eu/projects/kicstarth2/>

¹² <https://hydrogeneurope.research.eu/greenskills4h2-kick-off-meeting-6-7-july/>

¹³ See also the new Communication of the European Commission of 16 March 2023 to promote investments for sustainable hydrogen production: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A156%3AFIN&qid=1679087069513>

¹⁴ <https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/#:~:text=The%20Inflation%20Reduction%20Act%20is,technology%2C%20manufacturing%2C%20and%20innovation>

OPERATIONAL OBJECTIVES

The road map defines several operational goals for the development and use of the potential of hydrogen technologies, which are in synergy both with the European policies for the commercialization of hydrogen technologies and with the needs, interests and opportunities of Bulgaria for a stable and effective transition to ensure its carbon neutrality by 2050

Based on the analyzes carried out in the last two years, summarized in a special report "Assessment of the potential for the development of hydrogen technologies in the Republic of Bulgaria from 2022, the following operational goals have been defined¹⁵:

- (1) Promoting the consistent and effective introduction of technologies for the production, transportation and use of green hydrogen in industry, energy and transport;
- (2) Intensification of research and innovation;
- (3) Creating conditions for education and training for new professions and jobs and for an informed consumer and administrative environment related to hydrogen technologies;
- (4) Stimulation of European and international cooperation.

The creation of an adequate and stimulating regulatory framework, as well as the promotion of investments at the national and regional level in the sector, are horizontal conditions for the realization of the goals.

The operational objectives and the activities for their implementation frame the process of entering hydrogen technologies in industry (mainly petrochemical, chemical and difficult to decarbonize sectors) and transport, which needs institutional support accompanied by constant coordination and monitoring due to the dynamic and rapid development of this new and still little known matter.

The roadmap requires the participation of all stakeholders: state, business, science and innovation ecosystem, non-governmental sector and consumers. The implementation of the measures in the relevant directions implies the implementation of a comprehensive approach and connectivity of strategies, policies and specific operational and project activities in various sectors of the economy.

To fulfill the set operational objectives, the Roadmap defines a number of measures, presented in part 3, which in the next three years will contribute to ensuring a smooth and efficient transition to carbon neutrality in Bulgaria.

¹⁵ <https://www.mig.government.bg/reforma-c4-r7-razgrasthane-potenziala-na-vodorodnite-tehnologii-i-proizvodstvo-i-dostavkite-na-vodorod/>

3. IMPROVING THE CONDITIONS FOR DEVELOPING THE POTENTIAL OF HYDROGEN TECHNOLOGIES AND HYDROGEN PRODUCTION AND SUPPLY

1: PROMOTING THE SEQUENTIAL AND EFFICIENT IMPLEMENTATION OF TECHNOLOGIES FOR THE PRODUCTION, TRANSPORTATION AND USE OF HYDROGEN IN INDUSTRY, ENERGY AND TRANSPORT

The Bulgarian economy has the highest energy intensity in the EU (energy consumption per unit of GDP is almost three times higher than the EU average)¹⁶, as well as extremely high carbon intensity (4.3 times higher intensity of greenhouse gases than the EU average). Unfortunately, Bulgaria continues to lead the statistics on "Loss of years of life in good health due to air pollution" (2022)¹⁷. The average value of years of life lost due to air pollution¹⁸ with PM_{2.5} is 544 per 100,000 inhabitants, while for Bulgaria this value is 1552. In addition, the years of life lost per 100,000 inhabitants due to nitrogen dioxide (NO₂) pollution and ozone (O₃) are as follows: NO₂ - the average value for the EU is 109, for Bulgaria 245; O₃ – on average for the EU is 56, and for Bulgaria 64. This requires urgent and efficient measures, which are the main objective of the Green Pact, whose mechanisms must be used effectively.

1.1. Current condition

Hydrogen production and consumption in industry

Bulgaria, like other European countries, currently produces large-scale gray hydrogen for industrial consumption, mainly through steam reforming. The total amount of hydrogen consumed in the European Economic Area (EEA) for 2020 is estimated at 8.7 Mt.²⁰

According to data from Hydrogen Europe, Bulgaria ranks 12th in terms of hydrogen production out of the 32 EEA countries (Fig. 1) with about 200,000 tons per year or about 5% of the hydrogen in Europe (Fig. 2).

¹⁶ <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:52019SC1001&from=cs>

¹⁷ <https://www.eea.europa.eu/publications/air-quality-in-europe-2022>

¹⁸ <https://www.eea.europa.eu/publications/air-quality-in-europe-2022/health-impacts-of-air-pollution-table3>

¹⁹ refers to atmospheric particulate matter (PM) less than 2.5 micrometers in diameter

²⁰ https://hydrogeneurope.eu/wp-content/uploads/2022/10/Clean_Hydrogen_Monitor_10-2022_DIGITAL.pdf

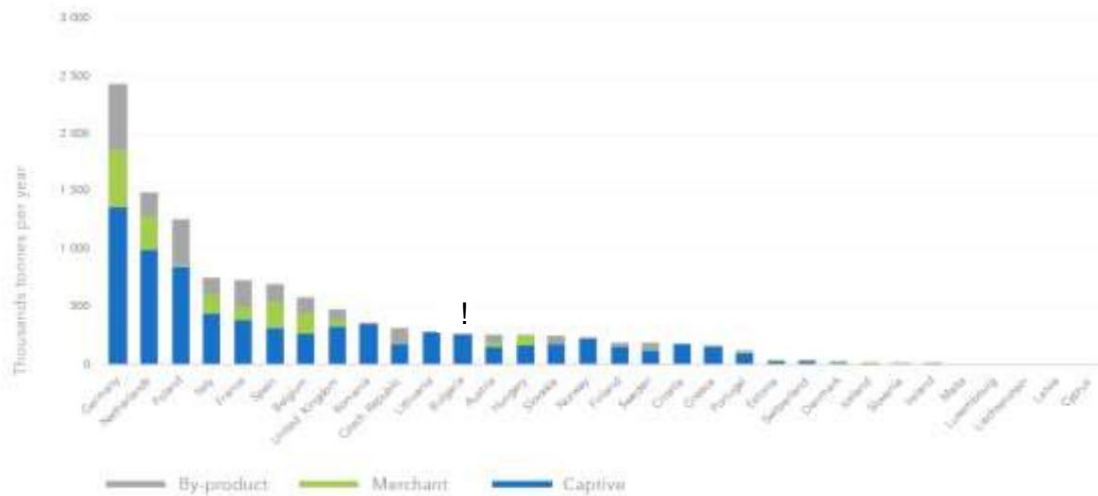


Fig. 1 Hydrogen production in the European Economic Area by country

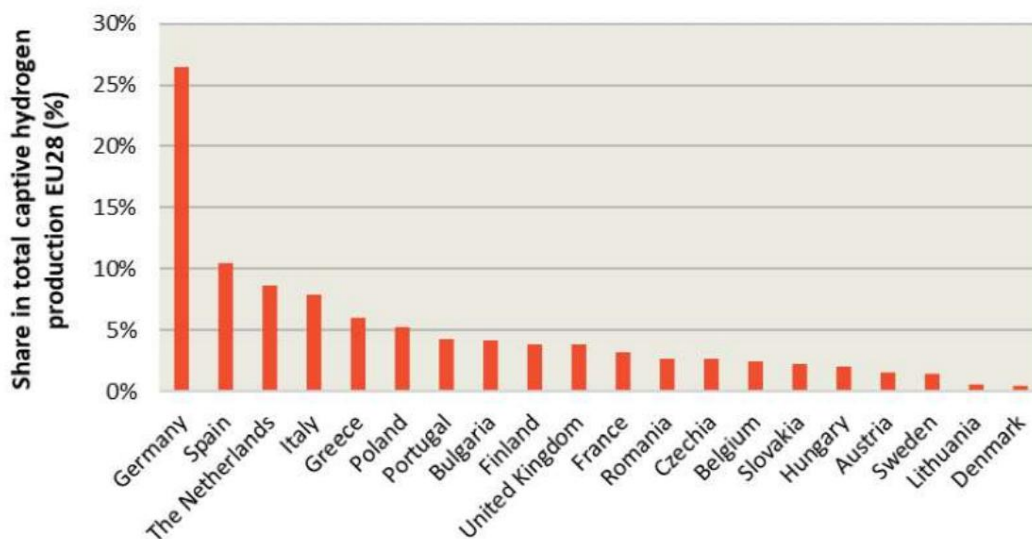


Fig. 2 Share of Member States in hydrogen production

Production of hydrogen for consumption in refineries

Lukoil Neftohim Burgas is the largest oil refinery in Southeast Europe and the largest industrial enterprise in the country. For the needs of its current production, the refinery uses about 80,000 t/y of hydrogen obtained through steam reforming, which releases CO₂ emissions of 720,000 t/y or about 40% of the refinery's CO₂ emissions. There are currently plans to expand productions that require additional amounts of hydrogen. ²¹

²¹ Own studies and company data.

Production of hydrogen in the ammonia industry

Ammonia is primarily used as a raw material for the production of nitrogen fertilizers. There are two nitrogen fertilizer plants in Bulgaria - in Dimitrovgrad (Neohim AD) and Devnya (Agropolyhim AD), and the second company organized its production by importing ammonia. The introduction of the taxonomy in the EU will lead to a rethinking of decarbonized ammonia import policies. If our country does not comply with them, we will have to give up the production of fertilizers - an industry for which, according to data from the Fuel Cells and Hydrogen Joint Venture (from 2022, the Clean Hydrogen Joint Venture), Bulgaria provides around 3% of ammonia production in the EU. The nominal capacity of Neochim AD for the production of hydrogen from natural gas is 55,300 t/y (50,000 t for 2019), with CO₂ emissions from steam reforming amounting to 503,000 t/y (450,000 t for 2019). The consumption of natural gas for the production of hydrogen is about 80% of its total consumption in the plant. In the production of green hydrogen, its consumption is expected to increase due to the interest in the production of new products. Preliminary forecasts show that, as a start-up, the ammonia plant in Dimitrovgrad (Neohim AD) will need 55,000 t/y of hydrogen. In the production of green ammonia, the product capacity will increase, therefore the demand for green hydrogen will also increase. In the case of the plant in Devnya, when switching to own production of green ammonia, the consumption can increase to about 150,000 t.²²

Production of hydrogen for the glass industry

In the glass industry, hydrogen is used as an inert or protective gas in the production of flat glass, for example for the automotive industry. It is also used in the flame polishing process. The factory in Targovishte "Pashabahche Bulgaria" uses green hydrogen in the molding stage of the glass products, and for this purpose a plant for the production of green hydrogen by electrolysis has been built.

Consumption of natural gas in high-temperature industrial processes

Natural gas is an important fuel in European industry. A significant part of energy consumption in industry is related to the generation of process heat. A large share (63%) is related to high-temperature thermal processes (>200°C). These processes are currently supported by fossil fuels because they are energy carriers with high energy density. The only low-carbon energy carriers that can be used in high-temperature thermal processes are solid biomass, biomethane/biogas and green hydrogen. In the short term, hydrogen can be mixed with natural gas in existing gas networks without the need to invest in regulating network components and end-use equipment, and heat treatment equipment (furnaces and burners) is expected to be able to accept 15 Vol. % H₂ with minor modifications. The largest consumer of natural gas in Bulgaria in high-temperature industrial processes is the glass industry, with leading companies in natural gas consumption "Trakia Glass", "BE Glass", "Rubin Trading". They are followed by the metal mining and metalworking industry with the largest consumers "Stomana Industry", "KCM 2000", "Sofia Med" and "Alcomet", the cement industry ("Zlatna Panega"). Apart from the production of hydrogen, about 0.3 million tons/year of natural gas is consumed in the industry, mainly for high-temperature processes. The hydrogen equivalent is 65 thousand tons of hydrogen. For Bulgaria, it is recommended that industries such as the glass and cement industries focus on CO₂ reduction

²² <https://www.clean-hydrogen.europa.eu/system/files/2020-08/Brochure%2520FCH%2520Bulgaria%2520%2528ID%25209473033%2529.pdf>

emissions by using mixtures of green hydrogen and natural gas, with a gradual transition to entirely green hydrogen. Developments to use 100% hydrogen in glass furnaces are at an advanced stage.

Summary: The analysis of the production needs of the Bulgarian hydrogen industry currently shows that they amount to about 150,000 tons/year. Hydrogen is mainly obtained by steam reforming of natural gas, which gives a carbon footprint of about 1400 Kt/g of CO₂. These data on CO₂ emissions do not include the use of natural gas for the high-temperature processes accompanying both the production and consumption of hydrogen, as well as those required for a number of other industrial processes. Bulgaria is a serious producer and exporter of ammonia and nitrogen fertilizers, which should preserve and further develop this sector of the green hydrogen economy, stimulating the production of green ammonia. Interest in this industry will grow due to the possibility of green ammonia becoming a shipping fuel. The quantities of green hydrogen required by the oil refining and ammonia industries cannot be provided entirely by local production of green hydrogen, therefore it will be necessary

the provision of hydrogen production from RES as an independent economic activity. In this case, the production of hydrogen from RES as an energy carrier and raw material will play an extremely important role in the decarbonization of the industry.

As for high temperature natural gas processes, it is next a serious source of CO₂ emissions from industry that can be decarbonized. One favorable factor is that a huge part of its consumption, comparable to that of Neochim AD (about 3 TWh per year²³ with a carbon footprint of 600,000 t/year of CO₂), is concentrated in about 10 plants from the glass, metalworking and cement industries, where at the European and global level, intensive work is being done to gradually replace natural gas with green hydrogen - from 15 to 100%. In this direction, there is already commercial production of burners that work on pure hydrogen^{24,25,26}. Of course, each of the plants should do their analysis and calculations (total cost of ownership) before proceeding with measures to decarbonize their production by introducing hydrogen, which will require financial support

tools.

The introduction of hydrogen technologies in the industry is related not only to the production of hydrogen at industrially affordable prices, but also to the retrofit (adaptation) of a number of production installations. For example, in the nitrogen fertilizer industry requires a serious transformation of the Haber Bosch²⁷ process that is used in Bulgaria. This modernization of a number of production processes will be necessary in the development of financial mechanisms to stimulate the decarbonization of the industry through the introduction of hydrogen technologies.

Hydrogen in transport

In Bulgaria, there are still no electric vehicles with a fuel cell, nor hydrogen charging infrastructure.

²³ <https://www.infobusiness.bcci.bg/ipi-4-5-2022.html>

²⁴ <https://emcombustion.es/en/hydrogen-burners-hydrogen-combustion-systems/>

²⁵ <https://global.toyota/en/newsroom/corporate/25260001.html>

²⁶ <https://www.fivesgroup.com/energy-combustion/reducing-carbon-footprint/hydrogen-combustion-solutions>

²⁷https://bg.wikipedia.org/wiki/%D0%9F%D1%80%D0%BE%D1%86%D0%B5%D1%81_%D0%BD%D0%B0_%D0%A5%D0%B0%D0%B1%D0%B5%D1%80-%D0%91%D0%BE%D1%88

Hydrogen transport with a fuel cell has not yet been established in Bulgaria. It is absent in the main strategic documents (Integrated plan in the field of energy and climate of the Republic of Bulgaria 2021-2030, NPR Bulgaria 2030, NPVU), in which electromobility means electric vehicles with a battery.

Hydrogen mobility appears for the first time in ISIS 2021-2027 : "3.1.5. Thematic area "Clean technologies, circular²⁸ and low-carbon economy: "development and implementation of technologies related to sustainable mobility (battery and hydrogen) based on hydrogen". In European documents, when electromobility is commented on, it is specified whether it is battery-powered: BEV (battery electric vehicle) or hydrogen-

FCEV (fuel cell electric vehicle).

At the same time, hydrogen mobility is shaping up to be a very dynamic market that requires technological solutions allowing greater autonomy. There is no automotive industry in Bulgaria, but the country specializes in developing components for the automotive industry, including and for the electric vehicle industry (electric motors, converters, inverters, etc.), which gives it opportunities to enter the value chain with the manufacture of certain components, or with assembly, for which, in addition to the existing expertise, a new one is also needed. The advantages of hydrogen mobility, especially for heavy-duty transport and long-distance transport, are indisputable over those of battery vehicles due to the possibility of long mileage and fast charging.

Pursuant to Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of infrastructure for alternative fuels, hydrogen is one type of alternative fuel. Bulgaria was one of the first 14 member states to officially adopt hydrogen as an alternative fuel.

Pursuant to Directive 2014/94/EU, the Ministry of Transport and Communications developed a National Policy Framework for the development of the alternative fuels market in the transport sector and for the deployment of the relevant infrastructure (NRP)²⁹, which was adopted by the Council of Ministers. Its goal was the creation of a favorable environment for the wider application of alternative fuels and drives in the transport sector and the achievement of conditions comparable in the field to other developed countries of the European Union. The stated goals for hydrogen were to have 50 EPSGCs by 2020. Pursuant to the National Policy Framework, Bulgaria developed a regulatory document (Regulation No. RD-02-20-2 of September 28, 2020) for the construction of hydrogen charging stations. Although today the regulation needs a serious update, this is the first normative document concerning hydrogen³⁰. In 2019, each member state was obliged to submit a National Report in compliance with the provisions of Art. 10, paragraph 1 of Directive 2014/94/EC on the deployment of infrastructure for alternative fuels with forecast data up to 2030 for the deployment of hydrogen vehicles and infrastructure, as well as investment support for deployment and production. The first National Report, which our country presented at the beginning of 2020³¹, practically created a realistic national framework for the introduction of hydrogen in the transport sector for the period 2020-2030, as were the requirements of the document. The data on Bulgaria's commitments under this document are: by 2025, to register 120 hydrogen vehicles

²⁸ <https://www.mig.government.bg/wp-content/uploads/2022/12/isis-2021-2027.pdf>

²⁹ <https://www.mtc.government.bg/bg/category/280/nacionalna-ramka-za-politika-za-razvitiето-na-pazara-na-alternativni-goriva-v-transportniya-sektor-i-za-razgrschaneto-na-solvetnata-infrastruktura>

³⁰ <https://www.lex.bg/bg/laws/ldoc/2137206003>

³¹ https://www.mtiic.government.bg/sites/default/files/national_report_bulgaria_alternative_fuels_3-01-2020-final.pdf

funds and to start functioning 5 charging stations. By 2030, their number should increase accordingly by another 599 means of transport (city transport, tourist buses, two-wheelers and passenger cars) and 14 charging stations. This plan was developed before the COVID-19 pandemic and the adoption of the Green Deal. There are prerequisites to at least double the number of EPSGK, as well as to adjust the distribution by types of vehicles with an emphasis on heavy goods transport.

On January 24, 2023, a second national report was submitted to the EC in compliance with the provisions of Directive 2014/94/EC.

Despite the lack of progress since 2017 in terms of the implementation of national commitments, expertise in Bulgaria on hydrogen mobility is growing, using a bottom-up approach driven by the research sector that exploits the advantages of hydrogen electric transport. Expertise is currently being established in hydrogen retrofitting of conventional vehicles and their conversion to electric. The first working group is developing a hybrid "fuel cell/battery" system, which will be integrated on a Sofia Municipality trolleybus, which will have 100 km/d of additional hydrogen mileage. Four projects have been developed in the most prepared municipalities - Sofia, Stara Zagora, Burgas, Ruse, which combine the introduction of urban hydrogen mobility with the relevant infrastructure, as well as the construction of production infrastructure and the development of propulsion systems through a hybrid system "hydrogen fuel cell/ battery".

Hydrogen in energy

Hydrogen from renewable sources and electricity from renewable sources are a key element of the ultimate goal of the European Union, including Bulgaria, for the integration of climate-neutral energy

system.

The "Energy" sector in Bulgaria is the largest source of greenhouse gas emissions in the country. Coal-fired thermal power plants account for almost half of the sector's emissions. The aspiration for decarbonization of the economy necessitates a large-scale reform of the energy sector in the country, which, in turn, is associated with significant investment needs. For example, at the basis of the future development of the sector, which is a structurally determining branch of the country's economy, are the effective use of local and alternative energy resources, the development of the internal energy market and development of smart networks, the engagement of citizens with the energy transition, the possibility that they to take advantage of new technologies to reduce their energy costs, their active participation in the electricity market.

A major challenge in the energy transformation will be the successful implementation of the reforms in the regions with a carbon-intensive energy sector, where complex, horizontal measures, high levels of investment and active measures in the social sphere will be required. Hydrogen can contribute to the realization of these reforms due to its potential to balance the electricity grid. Overproduction of electricity during peak hours for renewable energy produces hydrogen, which is stored and used for various purposes: (1) it can be stored and fed back into the grid via fuel cells, or (2) it can be used for other purposes such as fuel for hydrogen charging stations or injection to natural gas.

Hydrogen transport

The two main methods of transporting hydrogen gas are by pipe trailers and by pipelines. Hydrogen is also transported in liquid form. For now this one

approach is not yet a priority for Bulgaria, although the proposal for the Alternative Fuels Infrastructure Deployment Regulation requires liquid hydrogen charging stations to be located 450 km apart. After 2030, every 200 kilometers in the EU, drivers must have access to hydrogen refueling points.

When transported by trailer, up to 560–900 kg can be transported. hydrogen gas depending on the pressure and type of tanks. Pipe trailers are suitable for hydrogen mobility in the supply of hydrogen with centralized production to HC.

Transporting hydrogen through pipelines in large quantities is the cheapest approach, but requires higher initial investments (1-2 million euros/km). There are several thousand km of industrial hydrogen pipelines in Europe (Belgium, Germany, the Netherlands, France). In 2020, 11 gas transmission companies from 9 countries created the "European Hydrogen Backbone Initiative" with a program of hydrogen pipelines with a total length of about 7,000 km, covering North-West Europe. In 2021, four gas transmission companies from Slovakia, Ukraine, the Czech Republic and Germany joined forces under the "European Hydrogen Network Initiative" to develop a Central European Hydrogen Corridor. Preliminary calculations showed possibilities for annual deliveries from Ukraine of 1.3 million tons of hydrogen through existing gas networks.³² In 2022, the structure grew to 31 companies from 28 countries, among which Bulgartransgaz EAD³³.

Bulgaria has the capacity and ambition to export green hydrogen to other EU member states. EU member states need 20 million t/y of green hydrogen in 2030, and only half of the required hydrogen can be produced in the EU. The remaining half will be provided (10 million tons/year) through imports from countries with favorable conditions for renewable energy - mainly wind and sun. The climatic and technological potential of Bulgaria for the production of renewable energy ensures³⁴ the possibility that it can be transformed into hydrogen through electrolysis and exported to other member states. Germany, which is expected to import a large part of its hydrogen needs³⁵, is already doing research on importing hydrogen, incl. from Bulgaria. The creation of a European Hydrogen Network has become a priority in the REPowerEU plan. The transport corridors now cover the whole of Europe, with Bulgaria entering the South-East Corridor along with Greece and Romania, considering the new South-East Hydrogen Corridor under REPowerEU. By 2030, about 30,000 km are planned to be provided through REPowerEU routes, of which 60% will be pipelines built for natural gas. The corresponding financial support will be in the order of EUR 28-38 billion for pipelines and EUR 6-11 billion for storage.

On the part of Bulgaria, up to 18 billion cubic meters of natural gas pass annually through the pipeline of the national gas operator "Bulgartransgaz EAD" between Turkey and Romania (Strandja-Valchi dol-Kardam), which can absorb pure hydrogen up to a certain percentage without special modifications, i.e. by retrofit. The first studies are currently being carried out by the German Hydrogen Association for the transport of hydrogen from the South East Transport Corridor (Bulgaria, Greece, Romania, Ukraine) in terms of pipelines and production capacity. Even with 3% hydrogen injection, the quantities required are beyond the capacity of a single country to provide such production by 2030. For

³² <https://www.eustream.sk/en/about-us/press/news/initial-analysis-supports-feasibility-central-european-hydrogen-corridor.html>

³³ <https://ehb.eu/>

³⁴ https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3131

³⁵ https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/the-national-hydrogen-strategy.pdf?__blob=publicationFile&v=6

the transport corridor through Bulgaria at maximum flow, this quantity is of the order of 3 Mt/year. Bulgaria's active participation at the national level in the construction of the hydrogen network, combined with cooperation with neighboring hydrogen-producing countries, including with Turkey, would ensure the transportation of Bulgarian green hydrogen to Austria, Germany and other countries.

The adoption of the National Road Map will start the provision of a planned and balanced policy regarding the production of hydrogen for the decarbonization of the economy, but also for export to other countries. With a stable production of green hydrogen within the next ten years, exports could reach 30-40% of the total production.

In conclusion: The hydrogen economy opens up excellent prospects for Bulgaria in terms of energy efficiency and independence, and in particular, through the use of available natural resources for RES. Bulgaria is among the 11 EU member states that have already achieved a share corresponding to their 2020 target. Back in 2012, the country met the national mandatory target of 16% share of renewable energy in gross final energy consumption for 2020. The potential is much greater, as according to data from Hydrogen Europe³⁶, Bulgaria currently uses about 4% of its potential for renewable energy production.

National goals for a 27.09% share of energy from renewable sources (RE) in the gross final energy consumption by 2030 have been set in the National Energy Policy. In the two main sectors of the economy – **electricity production and transport**, the following shares have been set to achieve this goal. A 30.33% share has been set for **the electricity sector** to achieve the goal. The forecasts are that this share will be achieved by increasing the installed capacity of RES plants by up to 3,000 MW, and by 2030 it is predicted that 6,973 MW of RES plants will be connected to the electricity system. In the Integrated Energy and Climate Plan of the Republic of Bulgaria 2021 - 2030, an **estimated 14.2% share of energy from renewable sources in the "Transport" sector is set**, for the achievement of which the introduction of hydrogen and renewable electric energy will be promoted through the reforms and investments in NPVU in the field of green and sustainable mobility, as well as with the implementation of European projects.

Investments contributing to the achievement of the EU targets for the installation of a capacity of 6 GW of electrolyzers and the production and transport of 1 million tonnes of renewable hydrogen, set out in the European flagship initiative "Acceleration" by 2025 and planned in the implementation of only the pilot projects in the NPVU, envisages the construction of 55 MW electrolyzers, the production of 7,800 t/y of green hydrogen, the construction of infrastructure suitable for the transfer of hydrogen and low-carbon gaseous fuels. To this should be added the possibilities of using the investments from the various program and financial instruments at the national and European level, discussed in detail in part 4., in which, however, at the moment, no specific parameters have been determined regarding the production and use of green hydrogen. The latter is to be done within the framework of the Interdepartmental Mechanism for the implementation of the activities of the Road Map, based on the analyzes, assessments and forecasts included in it.

1.2. Measures to promote the production, transport and use of green hydrogen

In order to stimulate the production, transport and use of green hydrogen, measures of a normative and organizational-administrative nature are needed, as well as the development of analyzes and forecasts.

Production and consumption of green hydrogen in industry and energy

³⁶ Hydrogen Europe Clean Hydrogen Monitor 2020

1. Creation of quotas to replace the use of gray hydrogen with green hydrogen

Description: Carrying out research, analysis and setting deadlines and milestones for the transition to green hydrogen in industrial enterprises, using gray hydrogen with a horizon of 2030, subject to the delegated acts.

An immediate industrial application of hydrogen is the reduction and replacement of high-carbon hydrogen use in oil refineries, ammonia production, and for new forms of methanol production or

the partial replacement of fossil fuels in steelmaking. Ammonia production has huge potential for Bulgaria, as the introduction of the taxonomy will ban the use of gray ammonia in Europe. Replacing gray hydrogen with green hydrogen

in the ammonia industry and the refinery will initially provide a reduction of CO₂ emissions by about 2 Mt/year. The green hydrogen produced and used must comply with the relevant delegated acts and the greenhouse gas emission threshold.

2. Pilot projects and installations for green hydrogen; Hydrogen valleys

Description: Realization of Investment 5 from the NPVU: Scheme to support pilot projects for the production of green hydrogen and biogas; Development of investment measures in implementation of the territorial plans for a just transition for Stara Zagora, Kyustendil and Pernik, within the framework of the Just Transition Fund (FSP), the "Growth Regions" Program; Review of opportunities and planning of investment measures to promote pilot innovative and high-tech projects on the model of a "hydrogen hub". The construction of the first hydrogen valley also began with the installation of the first 5 MW of electrolysis with several end users of the produced green hydrogen in the region of Stara Zagora³⁷. In addition to European funding in the amount of 8 million euros, the project will receive equivalent co-financing from funds and programs implemented in the country, as well as from private investments. The further increase of hydrogen production for industry and for export in Stara Zagora's hydrogen hub can be realized in the bLion project. ³⁸ The Hydrogen Valley model can be replicated in other regions that invest in the construction of hydrogen valleys and production hubs (e.g. Burgas, Ruse, Razgrad, Plovdiv).

The decarbonisation of electricity production with the introduction of RES is an extremely important niche that requires research projects followed by pilot plants to combine renewable energy with hydrogen production through electrolysis, its storage and consumption according to the needs of the network. This is a suitable approach for the Maritsa Iztok Complex (mines and thermal power plants) for joint development with the Electricity System Operator

(ESO) of a model and program for the decarbonisation of the coal sector through the production and consumption of green hydrogen. A suitable financial instrument is the Fund for a just transition, where activities in this direction and similar ones are foreseen

investment measures are planned in the projects for Territorial Plans for Just Transition (TPSP) ³⁹, which are yet to be adopted.

3. Amendment of the electricity trading rules in order to create a framework for the participation of PtX capacities in the electricity market

³⁷ https://www.clean-hydrogen.europa.eu/system/files/2023-03/4%20ZAHYR_%20Bugaria%20-%20R.%20Grozeva.pdf ; <https://www.mig.government.bg/intervyuta/mariya-todorova-mir-razrabotvaneto-na-vodorodnite-tehnologii-e-predpostavka-za-povishavaneto-na-energijnata-sigurnost-na-balgariya/>

³⁸ <https://hydrogeneurope.eu/h2-talks/lighthouse-initiative/>

³⁹ <https://www.strategy.bg/PublicConsultations/View.aspx?lang=bg-BG&Id=7007>

Description: As the energy sector decarbonizes, the need for energy arbitrage will grow, and Power-to-X 40 green hydrogen capacities will play an important role in this activity. In this sense, by changing the relevant legislation

it should be possible for such installations to be full members of the energy market.

4. Development of a guide for the construction of hydrogen projects in the various sectors of the economy

Description: A guide aimed at investors wishing to implement hydrogen projects in the country should clearly describe the applicable regulatory framework for PtX technologies, identify the administrative authorities with the authority to issue the necessary permits and describe the administrative process for obtaining the latter, together with the applicable deadlines and requirements. The guide should take into account good practices at the European level, as well as be updated when the legislation changes.

Hydrogen transport

5. Assessment of the potential of Bulgaria as a producer and exporter of green hydrogen

Description: Assessment of the possibilities for the production and export of hydrogen to the EU member states, which includes an analysis of the costs for the production of green hydrogen on the territory of the country, the need for additional capacity from RES, incl. for capacity of electrolyzers, for hydrogen demand in the country and neighboring member states, incl. the costs and benefits of replacing fossil fuels, as well as an assessment of the necessary infrastructure for the realization of exports (gas transmission system, port terminals (along the Danube and the sea), connections to Romania and Greece, as well as studies on the possibilities and economic efficiency of transferring of hydrogen with pipe trailers and other factors of importance.

6. Analysis of the prospects, benefits and costs for the future of the gas transmission and distribution system in Bulgaria

Description: Assessment of the benefits and costs of adapting the gas infrastructure in Bulgaria (including additional studies on the possibilities of transferring hydrogen through pipelines: metal and polyethylene) and adopting a plan for its preparation for a climate-neutral economy. The activity is closely related to the preceding activity and complements it.

Hydrogen storage

7. Analysis of the possibilities for off-season storage of green hydrogen in Bulgaria

Description: Identification of opportunities for storage of large-scale quantities of hydrogen with an interseasonal perspective, incl. assessment of the possibilities for adaptation of the underground gas storage "Chiren" and of the technical and economic possibilities for the construction of new deposits in the salt deposits on the territory of the country, e.g. studies on underground hydrogen storage, such as in the Mirovo rock salt deposit).

40Power-to-X also known as PtX or P2X is a collective term for conversion technologies, which convert electricity into carbon-neutral synthetic fuels such as hydrogen, synthetic natural gas, liquid fuels or chemicals. They can be used in sectors that are difficult to decarbonize or, unlike electricity, stored for later use.

Use of hydrogen in mobility

Bearing in mind that Bulgaria represents an important transport corridor connecting Europe with the Middle East, there is potential to achieve a significant reduction in emissions from the transport sector. In this sense, hydrogen technologies will play a key role in the decarbonization of heavy-duty land transport, river and sea transport, as well as air transport.

Hydrogen electric transport has significant advantages in heavy-duty transport – buses, heavy-duty vehicles, trains, etc. Given the high level of urban air pollution, the introduction of hydrogen bus transport would alleviate emissions from urban transport. A niche with potential for development in Bulgaria is the hydrogen mobility of heavy-duty vehicles.

Specific measures can be:

8. Stimulation of transport with zero emissions, incl. the introduction of fuel cell-powered heavy-duty vehicles

Description: Stimulation through various financial mechanisms, e.g. through tax breaks and/or financial instruments of renewing the heavy-duty vehicle fleet from vehicles powered by conventional fuels to those powered by a fuel cell.

9. Identification of priority locations for the construction of hydrogen charging stations along the republican road network

Description: Identification of priority areas for the construction of hydrogen charging stations, taking into account the heavy traffic on the national road network and the need for its decarbonization. Drawing up a plan for the phased construction of at least 20 hydrogen charging stations, such as those on the TEN-T corridors⁴¹

must have a capacity of 2 t/d, relying also on the funds under the financial instrument Connecting Europe Facility. 10.

Assessment of opportunities and determination of priority areas

for the production of liquid and gaseous transport fuels of non-biological origin (RFNBO)

Description: In connection with the implementation of the targets for the use of liquid and gaseous transport fuels of non-biological origin (RFNBO) defined in legislative acts, part of the "Prepared for Target 55" package (Renewable Energy Directive, Fuel EU Maritime, ReFuelEU Aviation and the relevant delegated acts), Bulgaria must carry out an assessment of the potential for

the production and use of such fuels, taking into account the needs of existing land, water and air transport. In this sense, an analysis of the barriers and an assessment of the opportunities for the production of transport fuels of non-biological origin should be developed, as well as the creation of a certification system for the production of ecological hydrogen and RFBNO in accordance with the Renewable Energy Directive and the delegated act.

2: INTENSIFYING RESEARCH AND INNOVATION

2.1. Current condition

Bulgarian scientists have serious achievements in the development of the next generation of innovative solutions for hydrogen production, storage and conversion systems, which will continue to be developed nationally and

⁴¹ <https://www.mtc.government.bg/bg/category/298>

European level. To strengthen innovation, new expertise and international cooperation are needed, which can be done by introducing targeted funding to develop different types of partnerships between higher education institutions, scientific organizations and businesses, incl. hydrogen demonstration projects.

2.2. Stimulating research and innovation in the field of hydrogen technologies

Decarbonization in Bulgaria requires the introduction of fundamentally new technologies that must replace those based on fossil fuels, which is why research and innovation (R&I) will play a crucial role in technological transformation. With this Roadmap, conditions are created to support the first existing activities in this regard, as well as to upgrade them. However, R&D will require longer-term planning with a focus beyond 2050, which is aligned with longer investment cycles for industrial installations and infrastructure, for market absorption of scientific products. Research and innovation are important to the speed at which decarbonisation can be achieved, with corresponding costs and benefits.

11. Training of personnel in higher education. Stimulation of research and innovation activity

Targeted measures are needed to build high-tech and innovation potential. This process has already started with the preparation of master's programs in some Bulgarian higher schools, but these are still single initiatives that, due to the lack of a national hydrogen policy and funding, cover to a certain extent the criteria for a European master's program developed under . Within the newly constructed scientific infrastructures in

the TeachHy project ⁴²

Bulgarian Academy of Sciences, Technical University-Sofia, Sofia University "St. Kliment Ohridski", University of Chemical Technology and Metallurgy and University of Thrace - Stara Zagora, as well as with potential in higher schools in the country such as Plovdiv, Varna and Ruse, is partially conducted and therefore in-depth and high-quality training of doctoral students should be planned.

Description: Well-developed and commercialized components such as electrolyzers, scaling (above 20 MW) and their integration will require serious research activity at both low and high levels of technological readiness in various sectors such as: hydrogen in energy networks to facilitate the introduction of renewable energy and improving their stability; hydrogen transfer and storage; hydrogen in industry - new applications as raw material and energy carrier; transport – production of hydrogen for synthetic fuels; electromobility – development and service of hydrogen mobility with national specialization in retrofitting. Until now, the main investments in these areas of scientific research have been realized through the National Scientific Program "Low-Carbon Energy for Transport and Life (EPLUS)", and in the future it will be necessary to define other specialized research program(s) and partnership between higher schools (VU), scientific organizations (SOs) and industry, demonstration projects and implementation projects, including as Hydrogen Valleys. Therefore, it will be necessary to plan more competitive opportunities through FNI, NIF, Structural Funds - the Program "Research, Innovation and Digitization for Smart Transformation", as well as the Program "Education", the Program "Competitiveness and Innovation in Enterprises" and the Program "Regions in growth" and others. Research and innovation

⁴² <http://www.teachy.eu/>

capacity will be developed and built within pan-European cooperation and initiatives (see below, part 4).

3: CREATING CONDITIONS FOR EDUCATION AND TRAINING FOR NEW PROFESSIONS AND JOBS AND FOR AN INFORMED CONSUMER AND ADMINISTRATIVE ENVIRONMENT RELATED TO HYDROGEN TECHNOLOGIES

3.1. Current condition

One of the main issues facing the introduction of hydrogen technologies in the European economy and, accordingly, in the Bulgarian economy, is the creation of new highly qualified personnel - well trained and motivated, who will introduce and serve

these technologies.

Qualification and retraining in Europe is characterized by fragmentation and focus on the needs of certain manufacturing companies along the value chain. Several two-week schools are organized annually. At the same time, given the forecasts that the introduction of hydrogen technologies will open 1 million jobs in Europe by 2030, well-trained personnel as well as administrative capacity will be needed. In Bulgaria, the list of professions for professional education and training does not include a profession and, accordingly, a specialty related to hydrogen technologies, as well as licensed vocational training centers that could offer such training. Bulgaria is relatively

favorable situation, as it participates in two large European projects on qualification and retraining - GreenSkill4H2 and KICstar4H2 (see also below), co-financed by the Erasmus+ program and the European Institute of Innovation and Technology, respectively. The ambition is to develop a single European strategy for retraining in the area of hydrogen technologies.

3.2. Promoting education, training and capacity building

12. Promotion of professional education and training for the purpose of training middle technical personnel

Description: Identification of current and need for new professions and specialties from the List of Vocational Education and Training Professions and proposal for inclusion of new profession/professions; Development of state educational standards for the acquisition of professional qualifications, curricula and programs for professional training, national examination programs in connection with the Law on Vocational Education and Training (VET).

The two European projects, Accelerating Sustainable Hydrogen Uptake Through Innovation and Education (KICstartH2) - Project of the European Institute for Innovation and Technology and GreenSkills4H2 - The European Hydrogen Skills Alliance - Erasmus+ Project, in which partners from Bulgaria also participate, are an excellent base for the creation and training of relevant professions from the field of vocational education and training in several steps: interviews with interested industry about the potential needs of specialists; inclusion of new professions in the List of professions; preparation of curricula and programs for qualification acquisition or retraining in accordance with the latest market needs and wide dissemination and implementation of professional knowledge and skills, incl. in licensed vocational training centers (VTCs). This should be done in cooperation between national and international experts, relevant authorities, interested industry and trade organisations.

3.3. Building capacity and awareness among central and local administration and the general public by offering

short-term training program and information campaigns and materials

13. Building administrative and technical potential in the public administration

Description: Considering the expected amount of Power to X (PtX) projects, public administration at all levels must be prepared for their evaluation. This includes sufficient human and financial resources, as well as training in terms of technical and legislative knowledge of staff related to PtX technologies, to avoid unnecessary delays in the project evaluation process.

The measure should start by identifying the relevant units that will be responsible for the evaluation of hydrogen projects and their training. Within the framework of the KICstart4H2 project, a general training program has already been prepared, which is suitable for the public administration and can be started immediately.

14. Public awareness campaign regarding hydrogen technologies

Description: Preparation of information materials and conduct of information campaign on hydrogen technologies and their benefits in order to prevent the "not in my backyard" syndrome and improve understanding of them.

15. Safety training for hydrogen technologies

Description: Preparation of educational material regarding the safety of hydrogen technologies, aimed at employees of the Ministry of Internal Affairs (DG "Fire Safety and Protection of the Population" and DG "National Police"), the employees of the Emergency Medical Assistance Centers and other structures of the public administration .

16. Creation of a "digital one-stop shop" platform for energy and hydrogen projects

Description: The planned reform is within the framework of the NPVU and aims to reduce the administrative burden (both for households and companies) accompanying the renewal process when taking measures to increase energy efficiency, as well as to support citizens and businesses with information, technical assistance and advice on regulatory, technical and financial issues related to their energy efficiency projects. For this purpose, 6 territorial units will be created on a pilot basis, providing services on the principle of "one-stop service", and in a 24-month horizon, the activities will be deployed, covering all 28 regions of the country.

Introducing the possibility to submit documents and obtain all necessary permits for the construction of hydrogen projects through an electronic platform, including the construction of electrolysers, hydrogen charging stations and infrastructure for the transport and transfer of hydrogen.

4: PROMOTING EUROPEAN AND INTERNATIONAL COOPERATION

4.1. Current condition

Hydrogen technologies require high scientific potential and serious funding, which is achievable with the active inclusion of the Bulgarian scientific and innovation ecosystem in European programs and instruments:

European and international instruments available are: European Recovery Plan, European Structural and Investment Funds, EU Framework Program for Research and Innovation - Horizon Europe, Participation in the European Research Area, Digital Europe Program, Framework Program "Single Market", Connecting Europe Facility (Energy window, where H2 projects are eligible as Projects of Common Interest (exploration only) and as cross-border RES projects (for exploration and development), European Macro-Regional Strategies - Danube Strategy region, Interregional Innovation Investments, the European Maritime, Fisheries and Aquaculture Fund (EMFAF), a Just Transition Fund with an emphasis on renewable sources, upgrading existing investments to achieve high energy class and use of green technologies.

In 2008, **Europe's first Strategic Energy Technology Plan (SET) was structured**. Its aim is to accelerate low-carbon development through cooperation between Member States, businesses, research institutions and the EU itself. In 2008, the technologies European Energy Research Alliance (EERA) was also established with programs that follow the structure of the SET Plan in order to coordinate research activity in the Member States in accordance with the implementation of the Strategic Energy Plan.

Pan-European initiatives since the announcement of the Green Deal are:

• **"Important projects of common European interest" (VPOEI/IPCEI)** in the field of hydrogen, in which the initiative is on the part of the member states, and in which Bulgaria has so far failed to participate;

• **The European Alliance for Clean Hydrogen (ECH2A/ECHW)**, which aims to support the deployment of hydrogen technologies, working in four interrelated areas (roundtables): renewable and low-carbon hydrogen production, transport and storage, use in

industry, mobility and other sectors. The initiatives come from the companies that are members of the Alliance. One of the main objectives of the European Clean Hydrogen Alliance is to facilitate investments in clean hydrogen. The alliance does not finance, but logistically supports large projects through the creation of integrated European hydrogen value chains and profiles projects, including with investors. (Fig. 3)

In 2008, **the Fuel Cells and Hydrogen Joint Undertaking (Fuel Cells and Hydrogen Joint Undertaking)** was established , from 2021 the Clean Hydrogen Joint Undertaking (Clean Hydrogen Joint Undertaking) as a public-private initiative between the European Commission, European industry and European science with the aim accelerated commercialization of hydrogen technologies by funding research and innovation activities. Bulgaria is a member of the Research Group with the BAS (since 2014) and with the Institute for Sustainable Transition and Development (ISUDR) - Thrace University since 2021, as well as in the Group of National Associations under the Industrial Group with the Bulgarian Association for Hydrogen, Fuel Cells and energy storage.

In 2008, in addition to the establishment of EERA, associations and networks were also established, including Hydrogen Europe and Hydrogen Europe Research, as part of the SP FP and with a crucial contribution to the energy transformation.

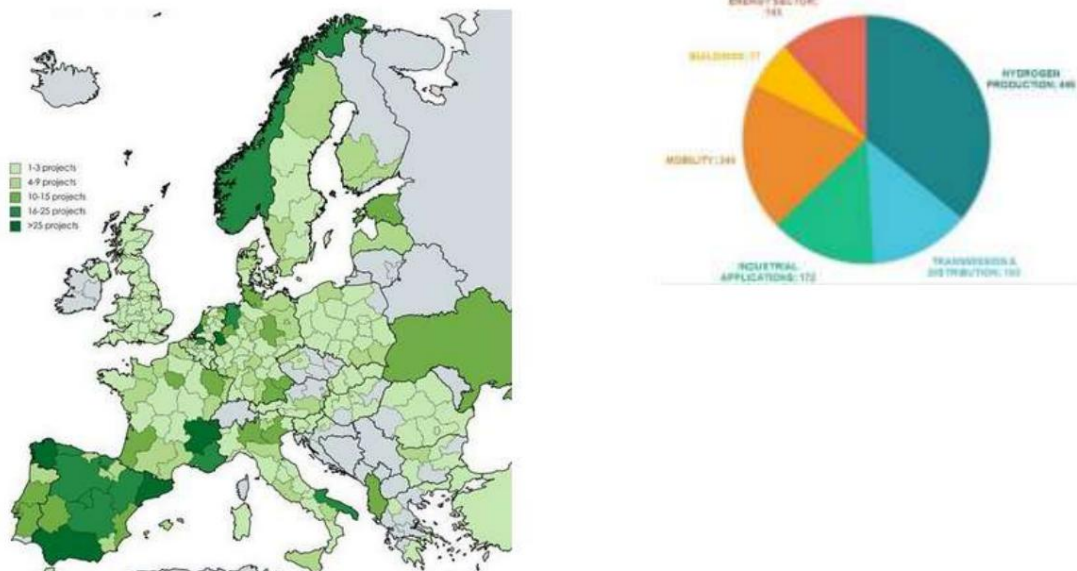


Fig. 3 Projects submitted to the European Clean Hydrogen Alliance by region (left) and by project type (right).
Source: European Alliance for Clean Hydrogen

At the same time, Central and Eastern Europe are not yet present on the European map of hydrogen technologies. In terms of hydrogen mobility, the last charging station is in Vienna, after which 2000 km follow. without charging station. Bulgaria is a country where there are no companies with long-term experience and investments in the development of hydrogen technologies, but it has a dynamic business environment and the potential to become a sustainable and energy independent country. The European Recovery and Resilience Plan and the Hydrogen Strategy further help to strengthen Bulgaria's commitment to the implementation of the ambitious goals of the European Green Deal, which can be achieved more effectively through cooperation. Bulgaria actively participates in the activities of a number of structures that work for the introduction of the hydrogen economy: membership in the SP CHV, membership in the European Energy Research Alliance, in the pan-European initiative to prepare a Strategic Research and Innovation Program for Green Hydrogen (SRIA), etc. . Bulgaria can actively assist in achieving the strategic European goals for 10 million tons of hydrogen production by 2030

, thanks to the excellent climatic conditions for the production, consumption and export of green hydrogen in cooperation with countries with more experience in hydrogen production. An important trend is the production of electrolyzers, fuel cells and other components along the value chain in Bulgaria.

4.2. New measures and initiatives at the European level

17. Active involvement in European projects and initiatives

Specifically by sector, the European Commission plans activities for the accelerated entry of hydrogen into electrification:

- Introduction of contracts for the difference in carbon emissions (Carbon Contracts for Difference, CCfD) and special components in the REPowerEU plan under the Innovation Fund to support the full transition of current hydrogen production in industrial processes from natural gas to renewable energy sources and hydrogen-based production processes in new industrial sectors such as manufacturing of steel;

⁴³ For more information: The European Alliance for Clean Hydrogen Joint Statement from the European Electrolyzers Summit, Brussels, 5 May 2022, available at < https://ec.europa.eu/commission/presscorner/detail/en/IP_22_2829 >. The capacity of the electrolyzer is

- In cooperation with the EIB, the Commission will develop a technical consultation mechanism within the framework of the InvestEU Advisory Center to support renewable energy projects. To boost industrial investment, the Commission is doubling the funding available under the 2022 call for large-scale projects under the Innovation Fund to around €3 billion. A dedicated component of REPowerEU will support:
 - o innovative applications for electrification and hydrogen in industry;
 - o innovative production of clean technologies (such as electrolyzers and fuel cells);
 - o medium-sized pilot projects for validation, testing and optimization of particularly innovative solutions.

In addition: in connection with the diversification of energy imports mandated by the European Council in March 2022, the Commission and Member States have established an EU energy platform for the voluntary joint purchase of gas, liquefied natural gas and hydrogen. On 5 May 2022, the EC and Bulgaria established the first regional working group as part of the platform in coordination with neighboring Member States from South-Eastern Europe.

REPowerEU can be implemented with qualified people, raw materials and a comprehensive regulatory framework, such as the EC:

- encourages renewable energy stakeholders (solar, wind and geothermal, biomass, heat pumps, etc.) and permitting authorities to establish a broad skills-building partnership under the Skills Pact;
- supports skills building through the Erasmus+ program and the Clean Hydrogen Joint Undertaking by launching a large-scale skills development project for the hydrogen economy.

An important point in the implementation of the pan-European REPowerEU plan is the mobilization of financial resources to cover short-term investment needs. In 10 years, great progress has been made towards bringing hydrogen technologies to market, but they must compete with technologies that have been developed in recent years and are established with traditional widespread infrastructure. More efforts are needed, financial support is also needed, for which the financial instruments of the European Recovery and Resilience Plan were created⁴⁴.

In REPowerEU, the Commission proposes:

- Targeted and rapid amendment of **the Recovery and Resilience Mechanism Regulation**. The amendment provides for the granting of additional financing in a limited amount from the sale through an auction of quotas within the ETS;
- Option for Member States to transfer up to 12.5% of their Cohesion Policy allocations to the Recovery and Resilience Facility, adding an option to transfer 7.5% for REPowerEU targets based on demonstrated needs and provided that Member States have used the possibility already available to transfer 5%;
- Under the InvestEU programme, to attract private financing to support a wide range of investments that contribute to the achievement of the policy objectives set out in REPowerEU by sharing risks with implementing partners. Cohesion policy funds that have a solid track record in supporting investments related to

measured in terms of input electricity, assuming an average electrolyser utilization factor of 43% and an electrolyser efficiency of 70%.

⁴⁴ European plan for recovery and sustainability, SWD(2020) 205 final, https://ec.europa.eu/info/sites/info/files/3_en_document_travail_service_part1_v3_en_0.pdf

energy, will continue to complement and strengthen the implementation of the goals of REPowerEU and the European Green Deal;

- Support under the Connecting Europe Facility - Energy (CEF-E) to RES that are not implemented under market conditions or otherwise not implemented within the time required to achieve REPowerEU objectives. Along with this announcement, the Commission is issuing a new call for proposals for CEF in the field of energy with a total estimated budget of around 800 million euros;
- Countries should consider introducing tax measures to support REPowerEU objectives so as to stimulate energy savings and reduce fossil fuel consumption.

In the same context, in his State of the Union Address in 2022, the President of the EC announced the creation of a new European Hydrogen Bank, which is to be an intermediary in the hydrogen market and to help ensure the purchase of hydrogen by use the funds from the Innovation Fund in the amount of 3 billion euros to support the construction of the future hydrogen market.⁴⁵

Bulgaria supports inclusion in activities and initiatives at the European level, while already actively working on projects within the framework of Interreg Europe, Horizon Europe and others. 8 Bulgarian companies (in .h. and Maritsa 2), as well as representatives of the scientific community. ZAHYR received approval for implementation from the European Commission and is considered one of the first projects to create a hydrogen-based economy in Bulgaria.

4. REGULATORY FRAMEWORK, PROGRAM AND FINANCIAL INSTRUMENTS AT EUROPEAN AND NATIONAL LEVEL

4.1. European legal documents

In recent years, intensive work has been done at the European level to adapt the legislation for the use of hydrogen technologies. An important step after the adoption of the Green Pact is the declaration of hydrogen as a key factor for decarbonizing the European economy. An important direction in the implementation of REPowerEU is the adaptation of legislation and the easing of administrative procedures in line with technological progress. A number of Directives and Regulations are to be updated (Industrial Energy Directive, Gas and Hydrogen Market Package, Energy Efficiency Directive, Buildings Directive, Rules

for renewable Hydrogen ⁴⁶ etc.) etc. discussed in detail in this part.

• On February 13, 2023, the European Commission adopted rules for determining hydrogen from RES in the European Union with the adoption of the two delegated acts to the Directive on the promotion of the use of energy from renewable sources

sources (**Directive (EU) 2018/2001**);

⁴⁷

• On February 10, 2023, the European Commission presented two key additions to **Directive (EU) 2018/2001** of the European Parliament and of the Council of 11

⁴⁵ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A156%3AFIN&qid=1679087069513>

⁴⁶ https://ec.europa.eu/commission/presscorner/detail/en/IP_23_594

⁴⁷ <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:32018L2001&qid=1676548626653&from=EN>

December 2018 to promote the use of energy from renewable sources. Renewable non-biological liquid and gaseous transport fuels are important for increasing the share of renewable energy in sectors expected to rely on liquid or gaseous fuels in the long term. The first supplement of **Directive (EU) 2018/200148** introduces new provisions to promote the use of renewable liquid and gaseous transport fuels of non-biological origin. The Commission is required to develop a robust Union methodology to ensure that the electricity used for the production of renewable liquid and gaseous transport fuels of non-biological origin is from renewable sources, including rules on (i) temporal and geographical coupling between the production facility of electricity and fuel production, and ii) ensuring that the fuel producer contributes to the deployment or financing of renewable energy. The second considered amendment to **Directive (EU) 2018/200149** introduces new provisions to promote the use of renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels. Although the directive sets a minimum threshold for reducing greenhouse gas emissions for renewable liquid and gaseous transport fuels of non-biological origin, it does not set a minimum threshold for reducing greenhouse gas emissions from recycled carbon fuels and does not specify the methodology for assessing the reduction of greenhouse gas emissions from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels. However, the Directive includes giving the European Commission the power to set such thresholds in delegated acts;

Ÿ On February 1, 2023, the Commission presented the new **Industrial Plan of the Green Pact for the era of net zero emissions**⁵⁰. The plan will be part of the European Green Deal, which is an initial step on the road to climate neutrality, and will enable Europe to take a global lead in the era of net-zero emissions industry. The starting point for the plan is the need to significantly increase technological development, production and installation of net-zero emission products and energy supply over the next decade, as well as the added value of a pan-European approach to jointly meet this challenge. Global competition for raw materials and skilled personnel is a difficulty. The plan aims to address this challenge by focusing on areas where Europe can have the greatest impact. The plan also aims to prevent the risk of replacing dependence on Russian fossil fuels with other strategic dependencies that could impede access to key technologies and raw materials for the ecological transition, through a combination of diversification and in-house development and production.

Ÿ **The first legislative initiatives on hydrogen mobility include:**

- Registration of hydrogen vehicles - the procedures are regulated in accordance with **Ordinance No. 1-45 of 24.03.2000**.⁵¹ for registration, report, stop and go, termination and reinstatement of registration

⁴⁸ [https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=PI_COM:C\(2023\)1087&qid=1676547639968&from=EN](https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=PI_COM:C(2023)1087&qid=1676547639968&from=EN)

⁴⁹ https://eur-lex.europa.eu/resource.html?uri=cellar:25ebddd-ab88-11ed-b508-01aa75ed71a1_0009_02/DOC_1&format=PDF

⁵⁰ <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:52023DC0062&qid=1676549731730&from=EN>

⁵¹ <https://www.strategy.bg/PublicConsultations/View.aspx?lang=bq-BG&Id=6772>

of motor vehicles and trailers towed by them and the procedure for providing data on registered vehicles;

- Harmonization of **EC Regulation (EC) No. 134/2014** of 2013 to supplement **Regulation (EU) No. 168/2013** of the European Parliament and of the Council with regard to environmental performance and amendment of Annex V (OJ L 53. 21.2.2014), in which technical requirements for testing L-category vehicles operating on hydrogen are regulated. The regulation also includes a definition of "alternative fuel vehicle"⁵²;
- Type approval of vehicles powered by hydrogen - the procedure is carried out in accordance with the requirements of **Regulation (EU) 2018/858** of the European Parliament and of the Council of 30 May 2018 on the approval and supervision of the market of motor vehicles and their trailers, as well as systems, components and separate technical assemblies intended for such vehicles;
- **Regulation (EU) 2019/2144** of the European Parliament and of the Council of 27 November 2019 on requirements for the type-approval of motor vehicles and their trailers, as well as systems, components and separate technical units intended for such vehicles, with regard to the general safety of motor vehicles and the protection of passengers and vulnerable road users, amending **Regulation (EC) 2018/858** of the European Parliament and of the Council and repealing Regulation (EC) No 78/2009, (EC) No. 79/2009 and (EC) No. 661/2009 of the European Parliament and of the Council and of Regulations (EC) No. 631/2009, (EC) No. 406/2010, (EC) No. 672/2010, (EC) No. 1003/2010, (EC) No. 1005/2010, (EC) No. 1008/2010, (EC) No. 1009/2010, (EC) No. 19/2011, (EC) No. 109/2011, (EC) No. 458/2011, (EC) No. 65/2012, (EC) No. 130/2012, (EC) No. 347/2012, (EC) No. 351/2012, (EC) No. 1230/2012 and (EC) No. 2015/166 of the Commission;
- **Regulation (EC) No. 79/2009** has been repealed and replaced by Commission Implementing Regulation (EU) 2021/535 of 31 March 2021 laying down rules for the application of **Regulation (EU) 2019/2144** of the European Parliament and of the Council regarding the uniform procedures and technical specifications for the approval of the type of vehicles and of systems, components and individual technical units intended for such vehicles, with regard to their general design characteristics and safety; Annex XIV of **Implementing Regulation (EU) 2021/535** relates to the EU approval of a vehicle with respect to its hydrogen system. Also **Regulation (EC) No 79/2009** applied to vehicles of categories M and N;
- Regulation No. 134 of the Economic Commission for Europe of the United Nations (UNECE) - Uniform prescriptions for the approval of motor vehicles and their components with regard to the safety-related characteristics of hydrogen fueled vehicles.

ÿ The Target 55 Package is a set of **proposals to review and update EU legislation** and to introduce new initiatives to ensure that EU policies are in line with the climate targets agreed by the Council and European Parliament. The package of proposals aims to provide a coherent and balanced framework for achieving the EU's climate goals, which:

- guarantees a fair and socially justified transition;
- preserves and strengthens the innovation and competitiveness of EU industry, while ensuring a level playing field for economic operators from third countries;
- underpins the EU's position as a global leader in the fight against climate change.

⁵² <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:32014R0134&from=BG>



Fig. 4 "Prepared for 55% target", Source: Consilium Europa

• The carbon cap adjustment mechanism

⁵³ is part of

the proposals under Prepared for Target 55. The aim is to create a World Trade Organization (WTO) compatible mechanism to equalize the price of carbon between domestic products and imports in selected sectors. In this way, the risks of carbon leakage in the EU are prevented.

Overall, the mechanism is expected to accelerate decarbonisation efforts both in the EU and abroad by equalizing the carbon price of domestic products and imports. With the phasing out of free ETS allowances, industrial sectors covered by the mechanism will be subject to the full price of carbon emissions. This would create a stronger incentive to decarbonize industrial processes. Thus, the role of green hydrogen is expected to increase, especially in sectors where there are few other alternatives, such as steel and fertilizer production.

• The EU Emissions Trading Scheme (ETS)

⁵⁴ is the EU's main policy for reducing greenhouse

gas emissions. It applies to all EU countries plus Iceland, Liechtenstein and Norway and covers energy-intensive installations (power plants and industrial plants) and airlines operating between these countries.

• In line with the objectives of European climate legislation, as part of the Ready for Target 55 package, the EC proposed a revision of **the ETS**. The proposal consists of five main elements:

- a reduced upper limit and a more ambitious linear reduction factor for emissions of greenhouse gases;
- revised rules for free allocation and stability reserve of the market;
- extension of **STE** to maritime transport; • introducing a new system for buildings and road transport and increasing the funds for innovation and modernization, as well as new rules for the use of **STE revenues**.

• **Strategy for the integration of the EU energy system according to the Green**. The strategy presents an "action plan" with **pact** ⁵⁵ specific policy and

⁵³ [carbon border adjustment mechanism_0.pdf \(europa.eu\)](#)

⁵⁴ [revision-eu-ets_with-annex_en_0.pdf \(europa.eu\)](#)

⁵⁵ [energy system integration strategy .pdf \(europa.eu\)](#)

legislative proposals, in particular those taking place under the Ready for Objective 55 package.

The main objectives of the strategy are:

- Decarbonization (along with reducing air pollution and energy water footprint);
- Increased energy efficiency and reduction of energy needs;
- Increased competitiveness of the European economy;
- Additional flexibility and storage capacity in the energy network;
- Improved sustainability and security of supply.

• **Hydrogen and decarbonized gas market package**⁵⁶

As part of the European Green Deal and the Ready for Target 55 package, on 15 December 2021 the Commission published its hydrogen and decarbonised gas market package, as well as a revised proposal for **the Energy Performance of Buildings Directive** and a proposal for reducing emissions of methane in the EU energy sector.

The package consists of revisions to **the Natural Gas Directive and the Natural Gas Regulation**, which set out common rules for the internal market in natural gas and, with the proposed revision, also for renewable natural gas and hydrogen. This aligns existing legislation with the provisions of the Clean Energy Package on incentives for clean energy solutions, consumer behaviour, easier switching of suppliers and clear certification of low-carbon hydrogen.

The last two actions are of particular importance for the hydrogen sector.

• **Innovation Fund**⁵⁷

The Innovation Fund is one of the largest programs for financing demonstrations of innovative low-carbon technologies in the world.

The fund covers:

- Innovative low-carbon technologies and processes in energy-intensive industries (eg introduction of renewable and low-carbon hydrogen in refineries, steel, cement and other energy-intensive industries where hydrogen is used);
- Construction and operation of carbon capture and storage (CCS) and carbon recovery (CCU);
- Energy reserve;
- Innovative production of renewable energy.

• Additional sectoral legislation relevant to the topic under consideration is also the Proposal for a Regulation on the use of renewable and low-carbon fuels in maritime transport and for amending Directive 2009/16/EC (**Fuel EU Maritime**) and the Proposal for a Regulation on ensuring equal conditions for competition for sustainable air transport

(**ReFuelEU Aviation**).

4.2. National legislation

With the adoption of REPowerEU, the decarbonisation criteria of the member states have increased. This necessitates updating the national priorities to reduce

⁵⁶ https://eur-lex.europa.eu/resource.html?uri=cellar:2f4f56d6-5d9d-11ec-9c6c-01aa75ed71a1.0001.02/DOC_1&format=PDF

⁵⁷ [EUR-Lex - 32019R0856 - EN - EUR-Lex \(europa.eu\)](https://eur-lex.europa.eu/eur-lex.do?uri=EN:EUR-Lex:32019R0856)

CO2 emissions by transposing European legislative initiatives to ease the introduction of hydrogen technologies into national legislation.

Despite the existence of a definition of green hydrogen in national energy legislation, there is practically no regulatory framework for hydrogen technologies. Considering their potential for sectoral integration, **the future regulatory framework should define concepts, rights and obligations regarding hydrogen technologies in energy legislation**, given that hydrogen production installations will have a role in the gas and electricity sectors as well as in transport and industry. **Power to Gas**

installations, depending on their configuration, **can be consumers of energy, producers of energy, as well as store it**. In order to harmonize the Bulgarian legislation with the European legislation, which is in the process of intensive development, related to the adoption of REPowerEU and in particular the Hydrogen Accelerator, a good knowledge of the changes and policies will be required, for which a management structure with high expertise should be created .

The ones identified in the report "Assessment of the potential for the development of hydrogen technologies in the Republic of Bulgaria"⁵⁸ barriers to the production, transport and use of hydrogen should be addressed in addition to the set of activities and measures presented in Part 3, also through relevant regulatory changes.

The following aspects of the regulatory framework require particular attention and follow-up:

In **industry**, as well as in relation to the economy in general, there is no significant improvement in energy efficiency, and statistical indicators show a significant need to reduce greenhouse gas emissions. As a result, the energy intensity of Bulgarian industry remains the highest in the EU. In this direction, the initial focus should be on replacing current hydrogen production with green hydrogen, as this is the most easily achievable goal. Next steps concern additional applications in hard-to-electrify sectors where hydrogen is highly suited as a decarbonization technology. Stakeholders must initiate a transition from gray to low-carbon hydrogen and further replace fossil fuels with the use of hydrogen. Regulatory authorities should ensure that carbon-free hydrogen production is counted as a renewable energy carrier. (e.g. as set out in **the Renewable Energy Directive**) and to set low carbon targets for all major uses of hydrogen (e.g. ammonia production). Such a transition would lead to a significant change in hydrogen production technology in terms of scale and cost, making hydrogen solutions more attractive not only for industry but also for other sectors. In addition, with the amendments to the legislation, the same environmental quality standards should be regulated for all energy technologies that enter the market in Bulgaria.

Regarding **the transportation** of hydrogen, there are no special texts on vessel pressure restrictions in the regulatory framework. The safety rules for the road **transport** of hydrogen are formulated in **Ordinance No. 40 of January 14, 2004** on the conditions and procedures for the carriage of dangerous goods,⁵⁹ which follows the European Convention on the International Carriage of Dangerous Goods

⁵⁸ <https://www.mig.government.bg/reforma-c4-r7-razgrasthane-potenziala-na-vodorodnite-tehnologii-i-proizvodstvo-i-dostavkite-na-vodorod/>

⁵⁹ <https://lex.bg/bg/laws/ldoc/2135479823>

goods by road (ADR) and Directive 2010/35/EU⁶⁰. The changes in the regulatory framework should simultaneously ensure the safety of transportation and avoid potential administrative barriers when transporting hydrogen at a pressure greater than 200 bar, due to a difference with the usual practice in Bulgaria. Another Ordinance that is applicable is **the Ordinance on the device, safe operation and technical supervision of pressure equipment**⁶¹

, with which controls the quality of pressure vessels.

At the moment, there is no clear regulatory framework in the **energy** sector regarding hydrogen technologies, with only fragmentary regulations in place. Starting with the definition of hydrogen, in §1, Art. 24e of the additional provisions to **the Law on Energy (LE)** defines the term "green hydrogen" as "hydrogen obtained by electrolysis or other technologies using renewable energy sources. This definition includes installations that produce hydrogen, by electrolysis or by other methods or other renewable sources

- biomethane, biogas, bio-waste, etc. The electricity used to produce green hydrogen is guaranteed to be of renewable energy origin. Subsequent changes to the regulatory framework on guarantees of origin should be in line with the Delegated Act and the Directive on the promotion of the use of energy from renewable sources.

In ZE, the concept of "green hydrogen" is also found in Art. 36e(1)1, where it is directed to the contributions to the Electricity System Security Fund for revenues from sold electricity. Under the provision, producers of green hydrogen electricity with facilities commissioned after January 1, 2021 do not owe a contribution to the fund.

Moving on to **the Law on Energy from Renewable Sources (REE)**, a draft Law on Amendments and Supplements to the Law on Energy from Renewable Sources (REE) has currently been developed. In the project of the ZID of ZEVI, the identified main barriers to the production of biogas and green hydrogen and the access to the transmission and distribution networks are addressed through:

1. provision of guaranteed access to the transmission and distribution networks in compliance with the security criteria proposed by the operators of the gas transmission and gas distribution systems and approved by the Commission for Energy and Water Regulation (KEVR);
2. guaranteeing the transfer and distribution of biogas and green hydrogen, at compliance with the security criteria under item 1;
3. non-allowance of discrimination in relation to biogas and green hydrogen in the determination of fees for transmission and distribution along the transmission or distribution network;
4. publication by the operators of the gas transmission and gas distribution networks of the tariffs for connecting sites for the production of biogas and green hydrogen;
5. mandatory purchase of biogas with a quality and pressure certificate and green hydrogen, according to a contract with the public supplier and/or final suppliers;
6. the possibility of issuing guarantees of origin (GO) for green hydrogen is regulated. A provision has been introduced that includes information on measures to stimulate the production and consumption of electricity, thermal energy and cooling energy from renewable energy sources, biogas and green hydrogen in the National Information System on the potential, production and consumption of renewable energy in Bulgaria ;
7. with the introduction of the GP for green hydrogen, it is planned to make amendments and additions to **Ordinance No. RD-16-1117 of 14.10.2011** for

⁶⁰ <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:32010L0035&from=bg>

⁶¹ <https://www.lex.bg/laws/ldoc/2135593393>

the terms and conditions for issuing, transferring, revoking and recognizing the GP of energy from renewable sources.

Pursuant to **Article 14 of Regulation (EU) 2018/1999**, Bulgaria is committed to submit to the EC a draft of an updated **Integrated Energy and Climate Plan of the Republic of Bulgaria (IPEC)** by June 30, 2023, in which the following to reflect the higher targets set in the Ready for Goal 55 package. In this regard, based on the expectations for the macroeconomic development of the country, the setting of requirements related to improving the energy intensity of the Bulgarian economy by placing energy efficiency in the first place, consideration of policies in the field of the environment and climate change, expectations for the future development of the energy sector, determination of new, more ambitious goals in terms of energy efficiency and the development of renewable energy, an estimated energy balance of the country will be prepared. An important element of the updated IPEC will be the determination of specific measures for the introduction of hydrogen technologies, allowing their sustainable use in the country's economy and energy sector.

Additionally, until there are clear rules from the EU, the national legislation will have to solve issues related to vertical and horizontal separation of ownership (unbundling); joining the energy infrastructure and injecting hydrogen into gas transmission networks (blending); applicable fees and taxation; as well as issues related to guarantees of origin for green hydrogen. Even more so after the adoption of the changes to **the Renewable Energy Directive (REDII)** regarding preferred areas for renewable energy production and facilitating the process of issuing permits in and outside the preferred areas, **it is imperative at national level to define preferred zones for RE and hydrogen production, as well as facilitating the obtaining of permits in and out of them.** The definition of these zones should respect the principle of subsidiarity, thus creating an opportunity to create a regional approach to hydrogen technologies. Changes will be required in the Law on Energy, in the Law on Energy from Renewable Sources, as well as in a number of regulations such as Regulation No. RD-16-1117 of 14.10.2011 on the terms and conditions for issuing, transferring, canceling and recognizing GP of energy from renewable sources and the creation of a new regulation for guarantees of origin for green hydrogen.

Other important legislative initiatives are expected in the Hydrogen and Gas Markets Decarbonisation Package, which revises **the Gas Directive 2009/73/EC and Regulation (EC) No 715/2009**. The conditions for using the existing gas pipelines for hydrogen transport will be defined - for the moment the maximum amount is 3%. Cross-border tariff costs will be removed, which will also ease the hydrogen market. In order to regulate the injection and transportation of hydrogen, it is necessary to revise the Ordinance on the design and safe operation of transmission and distribution gas pipelines and natural gas facilities, installations and appliances, as well as to undertake new legislative initiatives for the transportation of hydrogen.

Directive 2014/94/EU will be repealed once the Regulation on the Deployment of Alternative Fuels Infrastructure is adopted. In the Regulation, there are quantitative requirements regarding the hydrogen infrastructure, which must be laid down in a draft National Policy Framework for the development of the alternative fuels market in the transport sector and for the deployment of the relevant infrastructure in accordance with the new requirements. Another alternative is the future Electromobility Act.

Additional incentive measures that may find their place in the regulatory framework or other regulations may refer to encouraging the purchase of electrolyzers, exemption from connection tariffs, reduction of the price of purchased electricity for the production of green hydrogen, etc.

Bearing in mind that Bulgaria is an important transport corridor connecting Europe with the Middle East, with the right infrastructure investments and legislative changes, there is potential to achieve a significant reduction in emissions from the transport sector. In this sense, hydrogen technologies will play a key role in the decarbonization of **heavy-duty land transport, river and sea transport, as well as air transport**. According to Directive 2014/94/EU, **hydrogen is accepted as an alternative fuel, and hydrogen produced from renewable energy sources is recognized as a transport fuel of non-biological origin by Directive (EU) 2015/1513**.

Given the complex nature of the barriers in the transport sector in terms of the use of hydrogen, in setting the national targets for the transport sector and for the realization of the hydrogen ecosystem, an integrated value chain approach has been chosen and a whole system approach should be taken, focusing on hydrogen valleys. For this reason, legislation and initiatives at the European level include several aspects that are necessary to facilitate the transition to hydrogen, ranging from infrastructure (e.g. deployment of hydrogen refueling networks for the different modes of transport) to production techniques and market regulation.

Currently, at the national level, **Regulation No. RD-02-20-2 of 2020** has been developed and promulgated on the terms and conditions for the design, construction, commissioning and control of refueling stations for cars powered by hydrogen fuel (public., SG No. 86 of 2020). The update of the regulation could use the results of the SP GKV MultHyFuel 62 Project, in which Bulgaria participates and which aims to develop a common strategy for the implementation of hydrogen filling stations on the territories of existing gas stations.

Other aspects of the regulatory framework to promote hydrogen mobility may be aimed at financial incentives for the purchase of fuel cell electric vehicles, exemption from registration fees, tax and excise relief; free access to areas with limited access for vehicles (city center); preferential conditions for building hydrogen charging stations, etc. 63

The construction of a successful legislative and administrative framework requires a unified policy and the creation of the capacity of a competent administration to be protected from the phenomenon of "reinsurance", widely observed in a number of European countries according to HyLaw's analyses. Legal norms and regulations related to the applications of fuel cells and hydrogen, as well as the legal barriers to their commercialization in 23 countries, are identified in the mentioned project of the SP. Specific criteria and recommendations have been proposed for each of them⁶⁴. This document is up-to-date and can serve both for training and as a basis for some legislative reforms in Bulgaria. For the creation of an adequate regulatory and administrative framework, the Hydrogen Observatory of SP GKV⁶⁵ can be used

⁶² <https://multhyfuel.eu/>

⁶³ https://public.tableau.com/app/profile/fcho.observatory/viz/FCHO_National_Policies

⁶⁵ <https://www.fcobservatory.eu/>

especially in the "Policies" part (Policy-and-RCS)⁶⁶, where the zones are registered and the guidelines are identified in which Bulgaria should create policies to support the introduction of hydrogen technologies. A very important role will be played by the National Institute for Standardization, which must harmonize the European standards concerning hydrogen. A number of leading aspects such as electrolyzers suitable for TK 64, hydrogen charging stations, pressure vessels specific to hydrogen, etc. should find their place in its committees.

The above, as well as other general European directives and regulations and national legislation, which refer to general provisions related to the prevention of pollution during production on an industrial scale, the protection and assessment of the impact on the environment, the protection of health and safety of workers from risks associated with chemical agents, as well as for working with pressure equipment, etc., are presented in detail in Annex 1 to the Roadmap.

4.3. Programs and tools

Programs and financial instruments

An important point is the development of realistic **financial support programs and instruments**, without which emerging innovative technologies cannot achieve the mass take-off that is needed.

To achieve the national goals set in the strategies, eight member states (Austria, Belgium, Germany, Denmark, Poland, Portugal, France and the Czech Republic) allocate a total of 18.47 billion euros of public funds for hydrogen technologies. These are mostly non-exclusive funds distributed between different national funds and programs to reduce costs along the hydrogen value chain, certification and guarantees of origin, support for research, development and innovation. The strategies of Belgium, France and Poland also allocate funds to the sector from national recovery and resilience plans, and those of Denmark, the Czech Republic and Portugal also foresee funds from other sources. For the successful introduction of hydrogen technologies, it is necessary to update the national plans and programs, which will ensure the necessary investments for the implementation of hydrogen in the Bulgarian economy.

Taking into account the NPVU and the programs with European and national funding, in the next 10 years Bulgaria could foresee 3.2 billion euros "mobilized" and 0.5 billion euros of own funds, including private investments, as the main

program and financial instruments are presented below:

The strategic document that creates the basic conditions for the use of funds under European programs in the field of scientific research, innovation and competitiveness is the Innovation Strategy for Smart Specialization (ISIS) 2021-2027.

The strategy is the thematic enabling condition for specific objectives for innovation and skills under Policy Objective 1 "A more competitive and smarter Europe by promoting innovative and smart economic transformation and regional ICT connectivity" for the funds from the European Regional Development Fund, the European Social Fund+ and the Cohesion Fund for the 2021 programming period -2027. The strategy adequately reflects the introduction of hydrogen technologies and acts as a basic program document for determining the entire complex of measures for financing innovations in the program period 2021-2027, allowing the country access to resources under several programs:

⁶⁶ <https://www.fcobservatory.eu/observatory/Policy-and-RCS/National-policies>

Ÿ **The Competitiveness and Innovations in Enterprises Program (CIPIP) 2021-2027** is directly aimed at achieving intelligent and sustainable growth of the Bulgarian economy, as well as the implementation of industrial and digital transformation. The program envisages the provision of targeted support in the form of grants to Bulgarian enterprises in the main problem areas that slow down their transformation to a digital, low-carbon and resource-efficient economy. Innovations in the retrofitting of installations for operation with hydrogen may also be included in the PCIP:

- **Development of innovations in enterprises with a total budget of ~71.6 million BGN.**

(for innovations falling within ISIS 2021-2027 Thematic Area 5 "Clean Technologies, Circular and Low Carbon Economy").

The measure aims to support enterprises in their process of developing their own innovations in the areas of ISIS 2021-2027.

- **Implementation of innovations in enterprises with a total budget of ~298.1 million BGN.**

(for innovations falling within ISIS 2021-2027 thematic area 5 "Clean technologies, circular and low-carbon economy");

- **Energy efficiency in enterprises with a total budget of BGN 260.6 million.** Support for the implementation of energy efficiency measures, introduction and certification of energy management systems; introduction of energy consumption monitoring and control systems; use of electricity, heating and cooling energy produced from renewable sources for own consumption.

Ÿ **Program "Research, innovation and digitization for intelligent transformation" (PNIIDIT)** contributes to achieving the goals of the European Green Pact, which is adopted as the new growth strategy of Europe, aimed at building a modern, resource-efficient and competitive economy, which does not put at risk the protection, storage and increase of the use of natural resources. Leading horizontal

priorities are the transition to a green, blue and circular economy, as well as the digital transition. PNIIDIT is co-financed by the ERDF and the state budget of the Republic of Bulgaria. The total amount of the planned financing amounts to 1,093,446,112 euros (2,138,594,709 BGN), the planned contribution from the EU is in the amount of 885,510,000 euros (1,731,907,023 BGN), and the national co-financing is 207,936,112 euros (BGN 406,687,686). Regarding hydrogen technologies, the introduction of which in Bulgaria requires cooperation with partners having technological expertise, it is advisable to allow their participation as members of consortia on

the program. Another approach is a bilateral partnership based on ministerial level agreements. The following directions in which hydrogen technologies can find their place will be financed in PNIIDIT:

- **Green and Digital Partnerships for Smart Transformation -**

Strategic projects targeting small and medium-sized enterprises (SMEs) to increase their competitiveness by turning "green" challenges into opportunities. The aim is to create conditions for sustainable solutions by providing green and/or digital services, creating a market advantage through the introduction/development of "green and digital" solutions and eco-innovations;

- **Cooperation programs for innovation and knowledge transfer, technology transfer in the areas of European value chains.**

Joint programs between industry, SMEs and scientific organizations and universities to build long-term cooperation and achieve significant progress and contribution to the regional economy such as in the field of building hydrogen valleys;

- **Participation in European partnerships.** Funding will be provided for the participation of Bulgarian networks of enterprises, including and in partnership with research

organizations and higher schools in invitations to solicit project proposals under the relevant European (institutionalized) partnerships under the RP "Horizon Europe", which cover the priority directions of the Thematic Area "**Clean technologies, circular and low-carbon economy**" of ISIS 2021-2027.

The following reforms and investments are included within the framework of **the NAP**, which currently do not mark hydrogen technologies in both industry and transport, with the exception of Investment 5, which should become even more ambitious:

• **Economic Transformation Program (ETP):**

- **Investments for combining renewable sources (RE) for electric energy with facilities for local storage with a budget of BGN 200 million.** The received financing can be used for the acquisition of assets for the production of energy from renewable sources for own consumption and systems for its storage ;

- **Guarantee financial instrument for energy efficiency and renewable energy with a budget of BGN 146,687,250.** The instrument aims to meet the challenges facing Bulgaria in providing support for investments in the energy efficiency and renewable energy sector. It is intended to cover a wide range of financial products (eg working capital, including **revolving credit lines, investment loans, leasing**).

• **Investment 5: "Scheme to support green hydrogen and biogas production pilot projects".** The main objective of the measure is to provide support for the development of pilot projects enabling the introduction of green hydrogen and biogas with application in industrial production, as well as for their future use in transport and for the production of electricity and heat. The scheme will provide investment aid for new installations for the production of hydrogen from renewable energy and for new installations for the production of biogas;

• **Reform 5: Electric mobility.** The current objective is only to stimulate battery electromobility through the development of a wide network of infrastructure for alternative fuels (electric charging stations); the introduction of new legislation to encourage the deployment of electric charging infrastructure and zero-emission vehicles; the creation of incentives and changes in the regulatory framework for the construction of infrastructure for electric charging stations and incentives for the increase of zero-emission electric vehicles; installation of 10,000 public charging points for electric vehicles throughout Bulgaria;

• **Investment 7 "Green Mobility" - a pilot scheme to support sustainable urban mobility through measures to develop ecological, safe, functional and energy-efficient transport systems:** It covers 68 vehicles for public transport with zero emissions (urban and inter-urban), 27 electric charging stations for public transport vehicles. They need to be included

a similar number of hydrogen electric vehicles.

It is planned to support investments to support the production and use of hydrogen within the framework of **the "Regional Development" program 2021-2027** under **the Just Transition Fund (JTF)**. Investments in green hydrogen have been identified in the projects of **the Territorial Plans for a Just Transition (TPSP)** of the respective districts - Stara Zagora, Pernik, Kyustendil, which are currently in the process of preparation. In addition, in the process of

the specific amount of financial resources to be targeted for the activities related to the production and use of hydrogen is also to be specified.

Measures to update the national plans and programs, some of which were adopted before the pandemic and the war in Ukraine could be further updated in the direction of increasing the already planned investments, as well as the inclusion of hydrogen production and consumption in other reforms (e.g. Reforms 6 , 9 and 10) and investments and programs for the development of industrial zones and parks, for the national infrastructure for the storage of electrical energy from RES, etc.

In addition to direct financial support, it is important for the introduction of innovative hydrogen technologies to be supported **through policies to limit investment risk**. These can be grants, loans, tax incentives or CCfD (Carbon Contracts for Difference), which help reduce the risks of early projects and attract private investment (IEA 2022, 193). In Bulgaria, such policies are still quite rare. Some financial and non-financial incentives for the deployment of hydrogen technologies identified by the Fuel Cells and Hydrogen Observatory to be considered within the Roadmap implementation period are presented below⁶⁷:

- **Hydrogen production**

- o Subsidies for the purchase of electrolyzers;
- o Exemption from connection tariffs;
- o Price of purchased electricity for green hydrogen production at or below wholesale market price;
- o Exemption or reduction of certain components of the price of electricity used to produce green hydrogen for industrial

aims.

- **Hydrogen mobility of a fuel cell**

- o Financial stimulation for the purchase of fuel cell electric vehicles (private and company);
- o Exemption from registration fees;
- o Property tax relief;
- o Free access to areas with limited access for motor vehicles (city center);
- o Preferential loans for the construction of a hydrogen charging station;
- o Exemption from excise duty on production of green hydrogen.

- **Hydrogen injection into the gas network**

- o Preferential tariff for hydrogen when injected into the gas network;
- o Exemption or reduction of fees and tariffs for the gas network.

- **Hydrogen for re-electrification**

- o Capital cost subsidy for hydrogen re-electrification (with fuel cell or gas turbine);
- o Green hydrogen production bonuses for providing ancillary network services.

⁶⁷ https://public.tableau.com/app/profile/fcho.observatory/viz/FCHO_National_Policies

5. MANAGEMENT AND MONITORING

Management

The successful implementation of the Roadmap requires the introduction of a flexible structure to organize, coordinate and monitor its implementation, whatever results oriented.

The management structure of the Roadmap is subordinate to the Minister of Innovation and Growth, who creates a Coordination Mechanism, including:

- *Coordinating body/working group* at the Ministry of Innovation and Growth (MIR) for the implementation of the national road map. The coordinating body/working group, composed of representatives of the competent ministries, will coordinate and guarantee the implementation and set the necessary corrections regarding the achievement of the objectives. It must meet at least four times a year. To the coordinating body, *thematic or other type of working groups* can be created, which include representatives of science, business, social partners, civil society, etc.

- *Operational Group on Hydrogen (OGV)*, which includes experts in the field of hydrogen from the country and abroad, exercises ongoing control and monitoring, monitors changes in the regulatory framework and program funding of national and European level and informs in a timely manner about deviations and/or implementation difficulties that require changes in the concept of the Roadmap. In order to ensure the greatest possible transparency and participation of relevant stakeholders in the implementation process, the working group will be assisted by the Commission for the Development and Implementation of Innovations and the Circular and Bio-based Economy (CICC).

The management process will be carried out in a constant mode of coordination with other strategies that are expected to have an impact on the use of the potential of hydrogen technologies.

Monitoring and evaluation

MIR submits every two years a report evaluating the implementation of the Roadmap and the measures provided for in it. The report contains an assessment of the set goals, also regarding Bulgaria's contribution to European energy and climate and to the goals of the Paris Agreement for climate protection.

At the same time, the measures to be implemented are evaluated in terms of their impact on the energy system and on greenhouse gas emissions. This assessment should also include a review of the impact of regulatory, legal and financial instruments in terms of competition with alternative, potentially more effective or efficient decarbonisation options.

6. IMPLEMENTATION PLAN

Strategically goal	Operational objective	Activities	Budget	Deadline for implementation date (month and year)	Expected results	Indicators for performance		Responsible institutions		
						current target		leading	partner	
Usage of hydrogen for decarbonise hurt the economy and for an alternative on other energy sources	1. Encouragement on sequentially it and the effective introduction of technologies for production , transportation it and the use of hydrogen in industry, energy and the transport	1. Creation of quotas for replacement of the use on grey hydrogen		did not apply MO	June 2025	Created quotas	0	Reduced emissions of CO2 with min. 6 Mt/year.	PEACE	Ministry of Education and Culture
		2. Pilots projects and installations for green hydrogen; Hydrogen valleys 2.1 Pilots projects and installations for green hydrogen; 2.2 Hydrogen valleys	2.1:68 454 050 million BGN NPVU, – privately co-financed and not; 2.2: Chorizont Europe, hybrid funded is by programs within the new program period 2021-2027 d. and privately	December 2026	Pilots projects; Built hydrogen hubs valleys	1	Min. 10 pilot the project; Min. 2 hydrogen valleys started activities	MIR/ME ESO, Ministry of Agriculture and Food, Selskostopansk and academy, and MTS		

			funded is						
		3. Change on the rules for trading electricity and energy with goal making of frame for Participation of PtX capacities in the market on electrical but energy	did not apply mo	December 2024	Update our Rules	0	1 Update anni rules	KEVR	Bulgaria independent energy exchange
		4. Developed is on guide for construction of hydrogen projects in the various sectors of the economy	BGN 10,000 budget of MIR/Horizon Europe	June 2024	Developed manual	0	1 Manual Fr	PEACE	ME, Agency for Sustainable Energy Development, Bulgarian Investment for Agency, Fund manager of financial instruments MoEW, MTS, MII BA, social partners, etc.
		5. Assessment of the potential of Bulgaria as a country	BGN 20,000 MIR budget/	March 2024	Estimate assigned and developed	0	1 Rating MIR		MII, MTS, business representatives

		the products li exporter of green hydrogen	Horizon Europe						
		6. Analysis of perspectives them, the benefits and costs and preparation of plan for the future of gas transmission ata distributed fir system To Bulgaria	BGN 30,000 budget of MIR/Horizon Europe	September and 2024	Commissioned and developed analysis	0	1 Analysis MIR		ME, Bulgartransgaz EAD, Gas Distribution teleni companies Bulgaria, in Ministry of Economy and industry, Bulgarian Academy of Sciences, etc. on
		7. Analysis of opportunities they for off season Fr storage on green hydrogen in Bulgaria	BGN 20,000 - budget of MIR/ Horizon Europe	June 2024	Commissioned and developed analysis	0	1 Analysis MIR		Bulgarian Academy of on Sciences, etc.
		8. Stimulation of transport with zero emissions, incl. the introduction on heavy duty and vehicles	did not apply mo	December 2026	Proposed mechanisms and reliefs	0	Accepted mechanisms and relieved her	PEACE	MTS, Ministry of Finance, branch organizations an etc.

		powered by a fuel cell							
		9. Identifiers on early locations for construction on hydrogen charging stations in the Republic road kata network	did not apply mo	December 2025	Developed document	0	Determined and locations for at least 20 charging stations.	PEACE	Road Infrastructure Agency a, MTS, MRRB
		10. Assessment on opportunities they determine priority areas for production o of liquid and gaseous transportation fuels from non-biologists n origin 11.	BGN 20,000 - budget of MIR/ Horizon Europe	June 2024	Developed assessment	0	1 Rating MIR		
Creation on capacity for use the potential on	2. Intensifier eration of the research subjects her and innovations	Training of personnel with high education and stimulation	within the approved budget of an institution so for	2026	Preparation on specialists ; Prepared studies	2 explore nia	10 investigated and 50 specialist and, included in programs in	PEACE	MES, Higher schools, scientific units of BAS

hydrogen technologies		on you research shiny ^{and} innovation activity	relevant year				the sphere of the higher educated is		
3. Creation of conditions for educated is and training for new ones professions and work places and for informed a user ka and the administrator thatch environment related to hydrogen is technologies	12.	Promotion on the profession the flax education and training for the purpose of preparation on average technically staff	within the approved budget of an institution so for relevant year	December 2026	Preparation and requalification ation ^{on} specialists	0	50 specialist ^{and} ^{with} profession alna qualification tion	PEACE	MON Vocational high schools, vocational training centers ^{for}
	13.	Construction on administrator even and technically potential in public administration iya	BGN 5,000 – Horizon Europe, European projects, own means of relevant the administrator tion	June 2025	Identifiers early ^{and} prepared admin even staff	0	50 presented ate ^{on} central and local administrator ation trained	PEACE	Higher schools, BAS, Municipal regional schools ^{and} administrative our structures, ME, MRRB
	14.	Campaign to be informed ost ^{on} society by attitude on hydrogen technologies	BGN 3,000: Horizon Europe, other European projects (Erasmus+), own funds	June 2024	Prepared information nni materials and conducted information nna campaign	0	1000 brochures and 3 information sheets those meetings	PEACE	ME, ^{Higher} schools, municipalities, BAS, Selskostopansk and academy etc.

		15. Safety Training on the hydrogen ones technologies	BGN 10,000 - Horizon Europe, other European projects (Erasmus+), own funds	June 2024	Educational prepared a material	0	1 Material PEACE		Higher schools, BAS, etc.
		16. Creation on platform for "digital service one (Within Reform over 5 of the counter" the NPVU - p emphasis on energy and hydrogen projects)	NPVU	September and 2024	Established platform	0	1 Platform	Workgroup*: (ME, MRRB, AUER, MoF, NSORB, financial institutions, designers, consultants, business representatives, etc.) *According to NPVU	
	4. Stimulated is on the European one Fr and international the note collaborator yours.	17. Active inclusion in European projects initiatives	20,000,000 BGN - - Horizon Europe, Erasmus+ and other programs with European funds, incl. hybrid co-financed	December 2026	Implementation of projects with Bulgarian participation	3 started whether or approved and the project	5 realized our project	PEACE	Higher schools, BAS, organizations and business representatives, etc.

			and not private means						
	Horizontal activity	Normative changes in relation to European regulations and directives	did not apply mo	December 2026	European legislator introduced ness	3 norm nor the act	Min. 10 normative and the act	Minister it is competent tions relevant that legal matter	PEACE