LITHUANIA

Opportunities for **Hydrogen Energy Technologies** Considering the National Energy & Climate Plans

H2

FCH
FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Contract details
Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2 JU)
Study on Opportunities arising from the inclusion of Hydrogen
Energy Technologies in the National Energy & Climate Plans
(Ref. FCH / OP / Contract 234)
fch-ju@fch.europa.eu

Prepared by

Trinomics

ludwig bölkow systemtechnik

Graphic Design:
Ático, estudio gráfico® - aticoestudio.com

Table of content

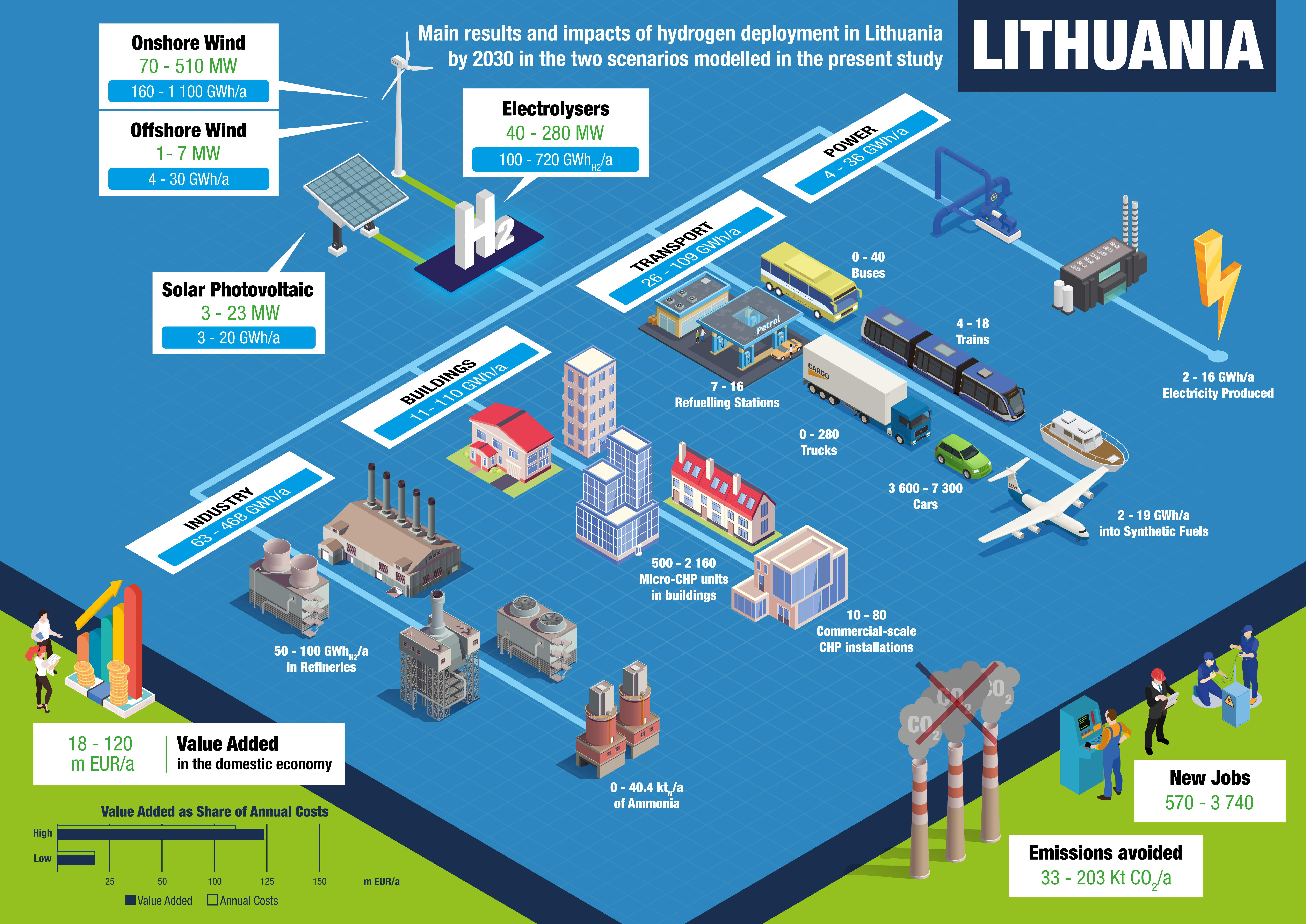
Introduction

The **Fuel Cells and Hydrogen Joint Undertaking** (FCH JU), in close cooperation with the **European Commission - DG Energy**, has commissioned a study on the "Role of Hydrogen in the National Energy and Climate Plans". This study is being conducted by the consultancies **Trinomics and LBST**.

This fiche represents one of the outputs of the study; it comprises two major parts:

- Analysis of **national opportunities for hydrogen deployment**, based on the national hydrogen production and demand potential, the gas infrastructure and the enabling environment. In this context, the role of hydrogen in the current National Energy and Climate Plan is in particular analysed.
- Assessment of **national economic, environmental and technical impacts of hydrogen deployment** under a high and a low scenario.

This information is expected to provide useful information to EU Member States that are considering to include renewable or low-carbon hydrogen deployment in their decarbonisation policies or roadmaps.



LITHUANIA
Main results and impacts of hydrogen deployment in Lithuania by 2030 in the two scenarios modelled in the present study
Onshore Wind
70 - 510 MW
160 - 1 100 GWh/a
Offshore Wind
1 - 7 MW
4 - 30 GWh/a
Electrolysers
40 - 280 MW
100 - 720 GWh_{H2}/a
Solar Photovoltaic
3 - 23 MW
3 - 20 GWh/a
H_2
POWER
4 - 36 GWh/a
TRANSPORT
26 - 109 GWh/a
BUILDINGS
11 - 110 GWh/a
INDUSTRY
63 - 468 GWh/a
0 - 40
Buses
4 - 18
Trains
7 - 16
Refuelling Stations
Petrol
CARGO
0 - 280
Trucks
3 600 - 7 300
Cars
2 - 16 GWh/a
Electricity Produced
2 - 19 GWh/a
into Synthetic Fuels
500 - 2 160
Micro-CHP units
in buildings
10 - 80
Commercial-scale
CHP installations
50 - 100 GWh_{H2}/a
in Refineries
0 - 40.4 kt_N/a
of Ammonia
CO_2
18 - 120
m EUR/a
Value Added
in the domestic economy
Value Added as Share of Annual Costs
High
Low
25
50
100
125
150
m EUR/a
Value Added
Annual Costs
New Jobs
570 - 3 740
Emissions avoided
33 - 203 Kt CO_2/a

EXECUTIVE SUMMARY

Lithuania's commitment for hydrogen deployment according to its NECP

According to its NECP, Lithuania considers hydrogen as "a promising area for energy innovation and an opportunity to acquire new energy competences". Launching a hydrogen market would allow "the capitalization of research efforts, the creation of new businesses, economic growth and exportation opportunities". [1]

Lithuania has joined the Hydrogen Initiative set up by EU Energy Ministers in Austria in September 2018. In its 2018 National Energy Independence Strategy[2], Lithuania expects that "the share of renewable electricity will continue to increase and, gradually, alternative fuels for transport, including hydrogen, will be deployed".

Lithuania has an enabling environment to address the deployment of renewable hydrogen, mainly in the transport sector, given its research and development activities and its commitment to build large variable renewable electricity capacities, whose integration in the electricity system could be facilitated by power-to-x deployment. Lithuania intends to be involved in the extension of the H2GO4 IPCEI project. It was not involved in the HyLaw[3] project, and could possibly carry out a similar assessment to identify and address its national specific barriers to the deployment of hydrogen.
Lithuania seems to consider hydrogen applications mainly from a RD&I perspective. Lithuania's NECP does not include specific objectives or targets for the production or use of hydrogen, nor hydrogen specific policies or measures.

The scenario assessment shows substantial potential benefits of hydrogen deployment in Lithuania by 2030

Hydrogen demand

Two (high and low) scenarios of hydrogen demand in 2020-2030 were developed, based on different levels of ambition linked to the national context. The resulting values are summarised in the scheme in the previous page. For Lithuania, a limited development of hydrogen demand is assumed in the considered scenarios in transport, especially for trains, and in navigation and aviation (through hydrogen-based liquid fuels or PtL)[4]. A limited development of hydrogen demand is also assumed in the scenarios in industry, especially in refining and ammonia production and for industrial energy use. These industries use fossil-based hydrogen as feedstock or reducing agent, which could be replaced by renewable hydrogen. Switching high temperature heat processes fuels to renewable hydrogen could represent another important potential use in the considered scenarios.

In the building sector, hydrogen can replace part of the current use of natural gas and can be distributed via existing gas grids through admixture to natural gas. The building sector is expected to have a more developed, yet still limited, demand of hydrogen by 2030. The scenarios assume only a marginal share of electricity generation from hydrogen by 2030, coming from combined heat and power installations.

Hydrogen production

To cover the estimated hydrogen demand from new uses and from substitution of fossil-based hydrogen, 0.1 to 0.5 GW of dedicated renewable electricity sources would have to be installed to produce green hydrogen via electrolysis. While "surplus" electricity might be available in times of high renewable electricity production, the main share will have to be covered by dedicated sources. In the two scenarios, part of the 2030 hydrogen demand would still be covered by fossil-based hydrogen produced via steam-methane reforming of fossil fuels.

In its NECP, Lithuania estimates the production of over 0.45 TWh of renewable electricity from variable sources in 2030. The technical potential for renewable electricity production in Lithuania seems however significantly higher.[5] Building additional renewable electricity capacity dedicated for hydrogen production thus could be a feasible scenario.

Estimated socio-economic and environmental impacts

The annual costs to produce green hydrogen (including the cost of dedicated renewable electricity sources), to develop the transport infrastructure (or adapt the existing one) and end-user applications would in the considered scenarios reach respectively 18 and 110 million EUR. These activities will generate value added in the domestic economy, amongst others by creating jobs in manufacturing, construction and operation of hydrogen technologies and will contribute to greenhouse gas emission reductions. This is in particular important in hard-to-decarbonize industries, such as steel production. According to the European EUCO3232.5 scenario[6] , the Lithuanian GHG emissions should be reduced by 3 Mt CO_2 in 2030, compared to 2015. In the scenarios considered, the deployment of hydrogen could contribute 30 – 200 kt CO_2 to this goal, which is equivalent to 1% - 6% of the required emission reduction.

[1] From Lithuania's NECP
[2] This information is coming from an unofficial translation of the "NATIONAL ENERGY INDEPENDENCE STRATEGY EXECUTIVE SUMMARY – ENERGY FOR COMPETITIVE LITHUANIA", http://enmin.lrv.lt/uploads/enmin/documents/files/National_energy_independence_strategy_2018.pdf, page 37
[3] https://www.hylaw.eu/
[4] Detailed assumptions are available in the methodology annex of the report, that can be consulted via the following link : http://trinomics.eu/project/opportunities-for-hydrogen-in-necps.
[5] The technical potential for renewable electricity production is based on the study commissioned by DG ENER Impact of the use of the biomethane and hydrogen potential on trans-European infrastructure (Trinomics, LBST, E3M; 2019).
[6] EC, 2019. Technical Note on Results of the EUCO3232.5 scenario on Member States. Available at https://ec.europa.eu/energy/sites/ener/files/technical_note_on_the_euco3232_final_14062019.pdf

HYDROGEN IN THE NECP OF LITHUANIA

According to its NECP, Lithuania considers hydrogen as “a promising area for energy innovation and an opportunity to acquire new energy competences”. Launching a hydrogen market would allow “the capitalization of research efforts, the creation of new businesses, economic growth and exportation opportunities”.

Lithuania expects to play an active role in the fourth industrial revolution, pursuing ambitious climate objectives while ensuring industrial competitiveness. Among the 9 Key Strategic Value Chains relevant for European development, Lithuania considers “hydrogen technologies and systems” as one of the priorities.

The Lithuania’s shift to an electricity system largely based on variable renewable energy (e.g. the current installed capacity of wind power plants is about 164 MW, and could increase up to 1322 MW in 2030, according to NECP’s estimation), will lead to high fluctuations in electricity generation and hence system balancing challenges. According to Lithuania’s NECP, the increasing flexibility needs could be covered, next to other options like energy storage, by hydrogen-based solutions (power-to-X). The gas infrastructure would be used to deliver and store renewable hydrogen produced from ‘excess’ electricity supply. For Lithuania, both transport and distribution methane networks are concerned, at the national and regional level. Lithuania plans to address these developments in the frame of regional cooperation, considering the electricity and gas system operations and capacity’s deployment in neighbouring countries.

Lithuania’s research in hydrogen technology and applications is well developed and active, with, among others, the Lithuanian Energy Institute (LEI) and the Vilnius Gediminas Technical University (this University has together with the company „SGdujos“ established the Laboratory for Experimental Research of Hydrogen as Fuel or Fuel Additive in Lithuania). These organizations follow closely all hydrogen and fuel cell related initiatives and research activities at EU level, LEI being member of the SET-Plan. The industry is also committed to invest in hydrogen research.

According to Lithuania’s NECP, the share of renewable electricity in the final electricity consumption is expected to reach 45% by 2030 and 100% by 2050. The share of renewable energy in the final energy consumption for transport is expected to reach 15% by 2030 and 50% by 2050. The first target will be an essential driver to produce renewable hydrogen from domestic resources, and the second target to use renewable hydrogen as an alternative fuel in transport.

OPPORTUNITY ASSESSMENT

Hydrogen production potential & its role in energy system flexibility

There is a great opportunity to utilize the potential surplus generation capacity in renewable electricity sources in Lithuania for hydrogen generation. The technical potential of variable renewable electricity generation is substantially higher than the forecasted overall electricity demand in 2030. According to the NECP, Lithuania would only use 0.15% of its technical potential in renewable electricity generation by 2030, so there is a great margin for building up dedicated renewable electricity sources for hydrogen production via electrolysis.

As the expected installed variable power generation capacity in 2030 will be higher than the average load, there is also an opportunity to utilize hydrogen production as a flexibility provider to the electricity system, even though there is in Lithuania also a substantial pumped-storage hydroelectricity capacity and interconnectors with neighbouring countries that can be used for flexibility purposes.

	Technical variable renewable electricity potential (TWh/yr)	Technical renewable electricity generation potential compared to forecasted gross electricity consumption in 2030 (NECP)	NECP estimate of variable renewable electricity production in 2030 (TWh/yr)	NECP estimate of variable renewable electricity production in 2030 compared to its technical potential	Ratio between variable power generation capacity in 2030 and average load (based on EUCO)	Readiness for CO_2 storage
Lithuania	300	2 938%	0.46	0.15%	129%	Low

Lithuania has limited readiness for wide-scale deployment of CCS. Although it has potentially suitable sites for CO_2 storage, there is only limited indication of progress towards using captured CO_2 in industrial processes and/or utilizing the potential storage capacities.

Energy infrastructure

Lithuania could assess the feasibility of using its existing methane infrastructure to transport and distribute hydrogen, either by blending it with natural gas or by converting (part of) its network to hydrogen. Hydrogen could be blended with methane in the existing grid, without the need for substantial physical adjustments to the transport, distribution and end-use infrastructure.

However, as the information regarding the share of polyethylene in the distribution network is not available, there are no indications regarding the technical and economic feasibility of a conversion to hydrogen; this aspect should be further assessed.

	Technical and economic feasibility of converting gas distribution networks to hydrogen (share of polyethylene pipelines in distribution grid)	Natural gas demand in residential and services sectors / length of gas distribution network (GWh/km)	Existing salt cavern natural gas storage sites (TWh)	Suitable geological formations (potential for future hydrogen storage)
Lithuania	N.A.	0.3	0	NO
EU	MS range 16%-99%			

To date, there are no salt cavern natural gas storage sites in Lithuania that could be used for hydrogen, nor underground salt layers that could provide suitable storage opportunities for hydrogen.

Current and potential gas & hydrogen demand

The assessment shows that in Lithuania, the largest opportunities for hydrogen are present in the transport sector, where hydrogen can contribute to the decarbonisation of road transport and the rail sector. On the medium to long term, hydrogen and derived fuels could also be deployed to decarbonise the international shipping sector and aviation. In industry, hydrogen could also play a role in the decarbonisation efforts. Hydrogen can be deployed to replace existing natural gas use in industry, but also for the provision of high-temperature process heat. Industries with existing use of hydrogen such as ammonia industry and refineries can switch from 'grey' hydrogen to renewable or low-carbon hydrogen on the short term. The opportunities for deployment of hydrogen in the built environment are more limited, although it can play a role in the replacement of direct fossil fuel use, foremost natural gas, but on the medium to long term also coal and oil. Lastly, hydrogen is one of the low-energy carriers that can replace fossil fuel use in district heating plants.

Opportunities for hydrogen demand in industry

Lithuania has a significant potential for hydrogen use in industry. First of all, the country has ammonia industry and refineries, both of which currently use fossil-derived hydrogen. In these industries with existing hydrogen use, there is an opportunity for early deployment of renewable or low carbon hydrogen to replace the fossil-derived hydrogen. Next to this, natural gas accounts for around a quarter of the industrial energy demand in Lithuania and this natural gas can be replaced with renewable hydrogen. Furthermore, 26% of the energy demand in industry is used to generate heat for high-temperature processes. Hydrogen is one of the low-emission energy carriers that is well-suited for the generation of high-temperature heat.

Presence of ammonia industry / share of ammonia production capacity in EU28 total	Presence of refineries / Share of Lithuanian refineries in total captive hydrogen production by refineries in the EU28	Share of Lithuania in total primary steel production in the EU28	Share of natural gas in industrial energy demand (2017)	Share of high-temperature (>200°C) process heat in industrial energy demand (2015)
6%	0.6%	0%	27%	26%
MS range 0%-16%	MS range 0%-26%	MS range 0%-30%	Average 32% MS range 0%-43%	Average 38% MS range 9%-60%

Opportunities for hydrogen demand for heating and cooling in the built environment

The opportunity for using hydrogen for heating in the residential and services sectors in Lithuania is limited, as natural gas has a very low share in the energy mix of these sectors. In Lithuania, around 70% of the final energy use in the built environment is used for heating and the direct use of fossil fuels only accounts for a very limited part of the heat supply, as most heat is supplied through district heating or generated through the combustion of biomass. Still, there is an opportunity for deploying hydrogen to replace this natural gas use in order to reduce GHG emissions. The same holds for the remaining use of coal and oil for heating, which could be replaced by hydrogen on the medium term. Apart from the direct fossil fuel use for heat generation, fossil fuels account for around a quarter of the energy inputs in dedicated (non-CHP) heat plants. Hydrogen is one of the low-carbon energy carriers that can replace this fossil fuel use on the medium to long term.

Share of natural gas in the household and service sector energy demand (2017)	Share of heating in the household and service sector energy demand (2015)	Share of cooling in the household and service sector energy demand (2015)
11%	72%	1%
Average: 34% MS range: 0% - 60%	Average: 74% MS range: 41% - 82%	Average: 3% MS range: 0% - 46%

Opportunities for hydrogen demand in transport

In the transport sector in Lithuania, the potential for the deployment of hydrogen lies primarily in the rail sector and in road transport. The rail sector in Lithuania is the most fossil dependent rail sector in Europe, with 95% of the energy use in the sector deriving from fossil fuels. Hydrogen trains are one of the low-emission alternatives for the current diesel trains. Next to the rail sector, the Lithuanian road transport sector is still heavily dependent on fossil fuels, like in the rest of the EU. Hydrogen is one of the solutions that can be deployed to decarbonise this sector. Especially in segments where electrification is difficult, such as heavy-duty road transport, hydrogen can offer a viable alternative. In Lithuania, heavy-duty vehicles and vans represent 41% of the energy demand in road transport, which means that there is significant potential for hydrogen deployment. Furthermore, the energy use for bunkering activities related to international shipping is significant. Although international shipping is currently not yet covered by European or international climate legislation, EU countries with large shipping activities need to make a collective effort to support the decarbonisation of this sector. Hydrogen and derived fuels are amongst the few solutions for (near) full decarbonisation of energy use in shipping on the long term and the same holds for the aviation sector.

Share of heavy transport (trucks, buses & vans) in total energy demand in road transport in 2020	Share of fossil fuels in energy use of rail transport (and absolute consumption) in 2017	Share of inland shipping in overall energy demand for transport in 2017	Energy use by international shipping relative to total (domestic) final energy use in transport in 2017	Share of domestic and international aviation in overall energy demand for transport (incl. energy use int. aviation) in 2017	Share of fossil fuels in energy use of road transport in 2017
41% (6 931 GWh)	95% (629 GWh)	0.3% (64 GWh)	8.9% (2 032 GWh)	5% (1 295 GWh)	97% (20 966 GWh)
Average 32% MS range 18%-48%	Average 30% MS range 0%-95%	Average 2% MS range 0%-9.8%	Average 14% MS range 0%-1011%	Average 14% MS range 1%-25%	Average 95% MS range 79%-100%

Enabling environment: national hydrogen policies and plans, projects and industry

The NECP's assessment shows that Lithuania has the intention to deploy the production and use of renewable hydrogen in order to facilitate the integration of increasing variable renewable generation in the electricity system. Lithuania aims to capitalize its research efforts, to use its natural gas infrastructure to transport and store hydrogen and to use renewable hydrogen as an alternative fuel in transport. Its NECP also mentions the industry and energy systems as potential users, but without concrete figures or applications. Lithuania is expected to take further actions to improve the enabling environment towards renewable hydrogen. So far, Lithuania has not set up a comprehensive framework for the deployment and use of renewable hydrogen.

Given its large potential for renewable hydrogen deployment, Lithuania could consider using renewable hydrogen as a key carrier within its energy policy to address the decarbonisation challenges in all energy end use sectors. Lithuania is expected to continue its coordination's efforts with the neighbouring countries to properly integrate hydrogen into the electricity and gas systems, also taking into account the initiatives and policies at EU level.

In the meantime, Lithuania is expected to continue supporting its research centres and industry to carry out hydrogen related research and to launch pilot and demonstration projects, which can contribute to paving the way for the use of renewable hydrogen as a means to achieve deep decarbonisation.

Existence of (or concrete plans for) national hydrogen roadmaps or strategies

Positive environment: ✕

An overarching hydrogen roadmap has not yet been developed; such a comprehensive roadmap would support the country in mainstreaming hydrogen within the energy system. The Lithuanian hydrogen and fuel cell association could provide support in structuring such roadmap, in close collaboration with the other Baltic countries, possibly in the frame of the Nordic Sea Hydrogen Network project. The association seems to focus at present mainly on research and could enlarge the scope of its activities.

GHG mitigation gap in non-ETS sectors (need for additional GHG reduction measures)

Positive environment

Lithuania's 2030 target for greenhouse gas emissions in sectors not covered by the EU Emissions Trading System (non-ETS) is -9 % compared to 2005 as set in the Effort Sharing Regulation (ESR). The NECP seems to indicate that the planned additional measures may be enough to reach the target. Replacement of fossil fuels by renewable hydrogen in the building, industry and transport sectors could contribute to ensure that the target is effectively reached.

Existence of (active) hydrogen national association

Positive environment: ✕

Current and planned hydrogen refuelling infrastructure for the transport sector

Alternative fuels infrastructure directive (2014/94/EU)

The Lithuanian National Policy Framework (or NPF set in the context of the alternative fuel infrastructure directive (2014/94/EU)) does not include specific targets or measures regarding hydrogen infrastructure for transport.

	Inclusion of hydrogen in national plans for the deployment of alternative fuels infrastructure (2014/94/EU)	Existence of hydrogen refuelling stations (2019)	which is equivalent to 1 refuelling station per … cars
Lithuania	NO	0	N.A.
EU		Total 156	Average 1 677 543

Existence of (investment on) hydrogen-related projects

There are currently no hydrogen-related industrial projects in Lithuania.

	Existing R&D and pilot projects directly related to hydrogen	RD&D annual expenditure on hydrogen & fuel cells (m EUR) (average 2013-2017)	Activities and projects in industry to use hydrogen as feedstock	Number of power-to-gas projects (existing and planned)
Lithuania	NO	0.0	NO	0

Existence of national tax incentives (CO_2 pricing mechanisms & car taxation)	Positive environment
There are in Lithuania no specific national carbon taxes on energy consumption that would encourage the use of renewable or low-carbon hydrogen. The tax regulation mechanism in place is exempting hydrogen-fuelled vehicles from environmental pollution tax on mobile source emissions.	✓

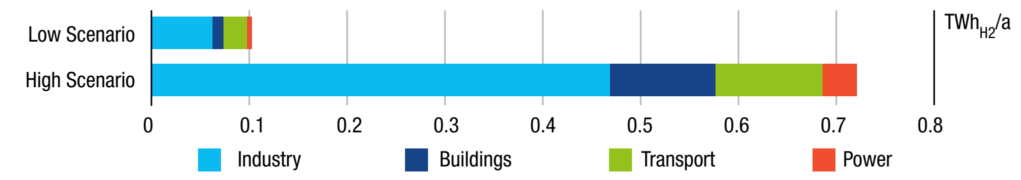
Fossil energy import bill

Like many EU Member States, Lithuania is strongly dependent on imports for its natural gas as well as its oil consumption. Switching from fossil fuel to nationally produced hydrogen for industrial processes, heating and transport applications will contribute to reducing the import dependence and bill.

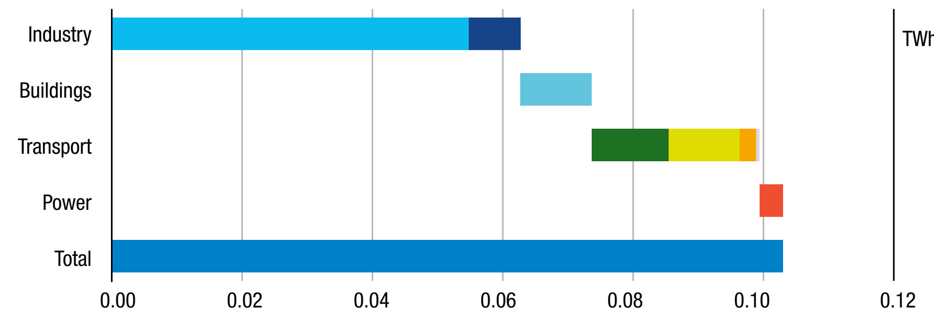
	Import bill for natural gas as share of national Gross Value Added	Import bill for all fossil fuels
Lithuania	1.2%	2.7%
EU	Average: 0.6% MS range: 0% - 1.5%	Average: 2% MS range: 0% - 7%

SCENARIO ASSESSMENT
Estimated renewable/low carbon hydrogen demand for Lithuania by 2030

Hydrogen demand in the year 2030 has been estimated in a low and a high scenario covering the range of uncertainty. Today, conventional hydrogen mainly used in industry is produced from fossil fuels (e.g. through steam methane reforming) or is a by-product from other chemical processes. Both scenarios assume that in 2030 renewable hydrogen will be provided to partially substitute current conventional production and to cover additional demand (e.g. from transport sector).

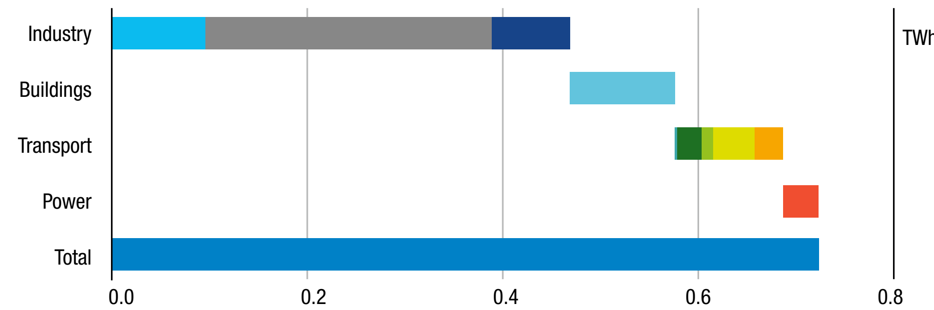


Low scenario



In the low scenario, renewable hydrogen accounts for 0.2% of final total energy demand (i.e. 0.1 out of 47 TWh/a) or 2.2% of final gas demand (5 TWh/a) according to EUCO3232.5.

High scenario



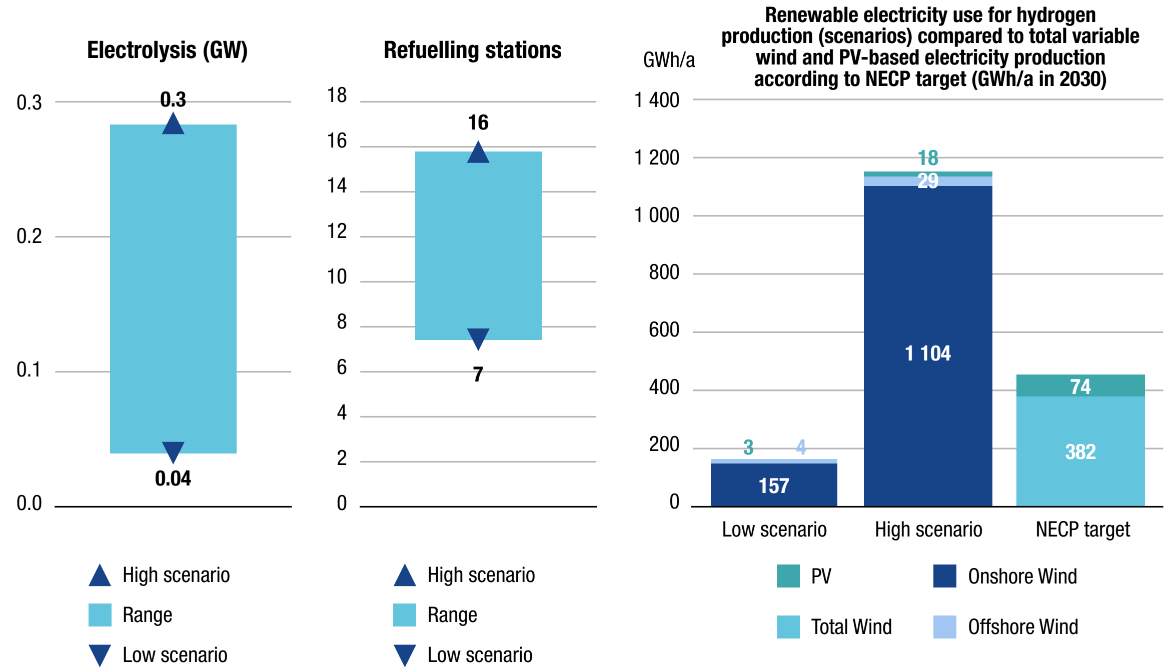
In the high scenario, renewable hydrogen accounts for 1.5% of final total energy demand (i.e. 0.7 out of 47 TWh/a) or 15.3% of final gas demand (5 TWh/a) according to EUCO3232.5.

Refinery
Ammonia
Methanol
Iron & steel
Industry energy
Buildings
Buses
Cars
Trucks
Rail
Aviation
Inland navigation
Power

Hydrogen generation, infrastructure and end users in Lithuania by 2030

The analysis of renewable hydrogen generation, infrastructure and end use is based on the demand estimates presented above. Renewable hydrogen is generated from variable renewable power using electrolysis. The analysis covers only national hydrogen production to satisfy domestic demand and does not take into account any cross-border trade of hydrogen (i.e. hydrogen imports and exports are not included in this analysis).

Renewable hydrogen generation and infrastructure



The required renewable power production accounts for 0.1% of the overall technical renewable power potential in the low scenario and for 0.4% in the high scenario.

End users

End user	Unit	Low scenario	High scenario
Passenger cars	Nº	3 600	7 300
Buses	Nº	0	40
Lorries	Nº	0	200
Heavy duty vehicles	Nº	0	80
Trains	Nº	4	18
Substituted fuel in aviation	GWh/a	2	17
Substituted fuel in navigation	GWh/a	0.2	1.5
Micro CHP	Nº	500	2 160
Large CHP	Nº	10	80
Iron&Steel	% of prod.	0%	0%
Methanol	% of prod.	0%	0%
Ammonia	% of prod.	0%	5%

According to the estimations, the hydrogen refuelling station network will by 2030 encompass between 7-20 stations for 4 000-8 000 fuel cell vehicles on the road. [7]

Further use of renewable hydrogen is foreseen in ammonia production (up to 5%).

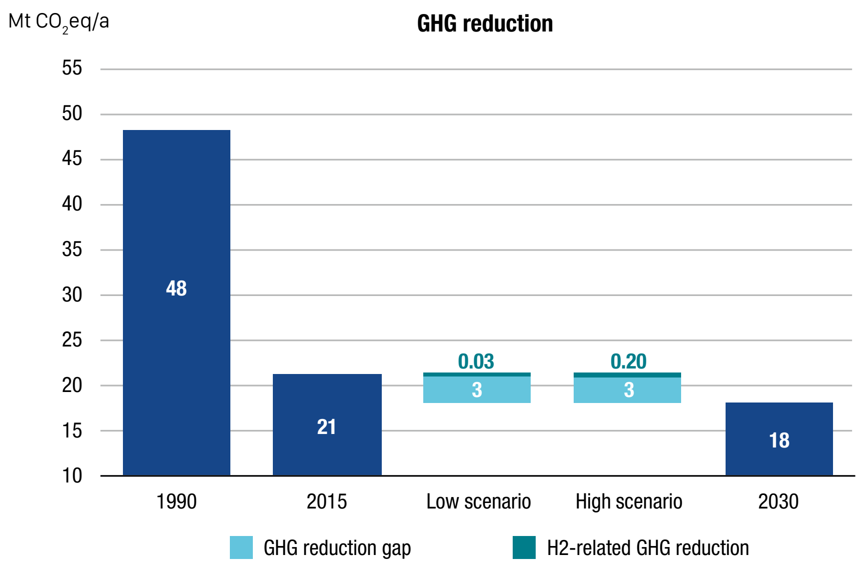
Finally, the introduction of 510-2 240 stationary fuel cells for combined power and heat production is estimated.

[7] *In order to ensure a minimum coverage of the country with hydrogen refuelling stations, more stations may be necessary for supplying hydrogen to the vehicle fleet.*

Environmental and financial impact in Lithuania by 2030

Greenhouse gas (GHG) emission reductions were calculated by estimating the fuels replaced by hydrogen, and their respective greenhouse gas footprint. Comparing these to the 2030 GHG reduction targets results in the contribution of hydrogen to achieving these targets.

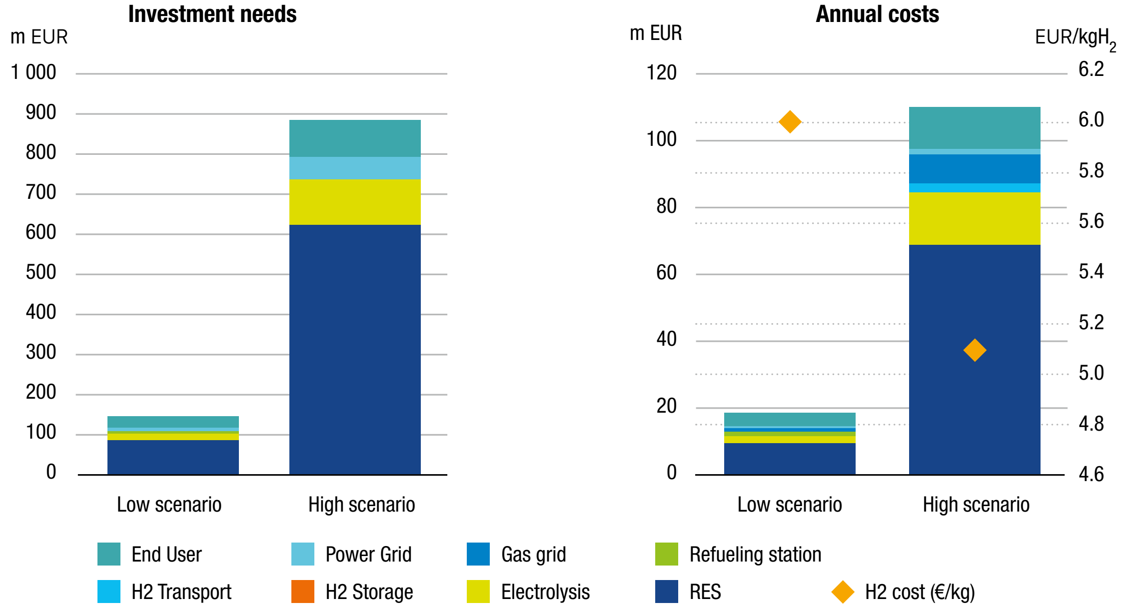
Environmental impact



An additional GHG emission reduction of 0.03-0.2 Mt CO_2 is estimated in 2030 corresponding to 1.0%-6.4% of the overall GHG emission reduction gap towards 2030 target (based on EUCO3232.5).

Financial impact

The financial scenario assessment includes investments (CAPEX) until 2030 and operating expenses (OPEX) per year in 2030. Cumulative investments in hydrogen technologies are estimated at 0.1-0.9 billion EUR until 2030, while annual expenditure would amount to 20-110 million EUR (including end user appliances as well as power and gas grids).

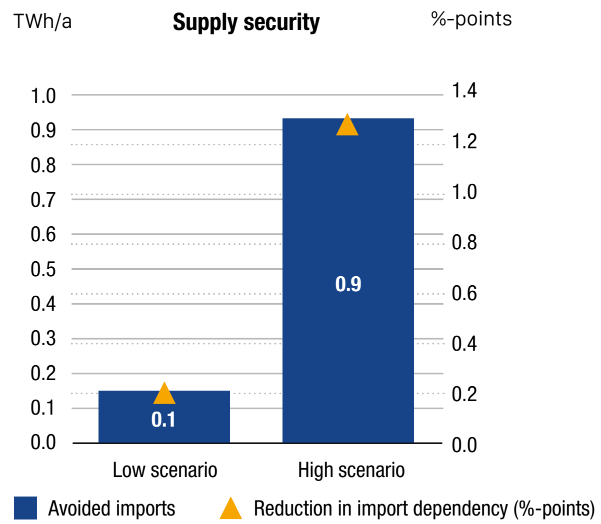


Impact on security of supply, jobs and economy in Lithuania by 2030

Hydrogen contributes to the energy supply security objective by reducing fossil energy import dependence and enhances energy supply diversification by facilitating deployment of renewable energy sources. This is assessed by estimating imported fossil fuels that will be replaced by hydrogen based on domestic renewable sources.

Security of energy supply

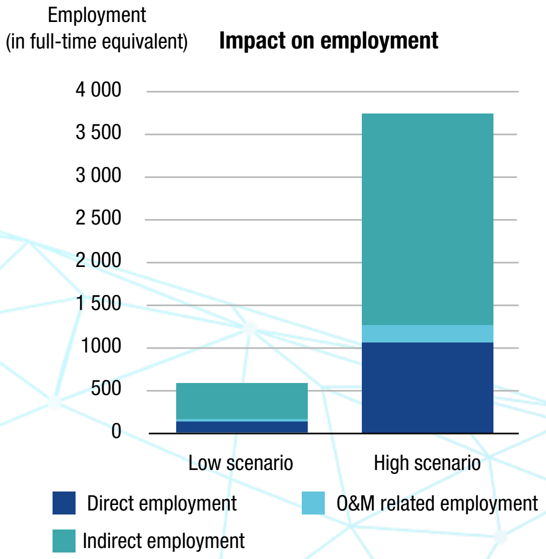
Deployment of renewable hydrogen would lead to 0.1-0.9 TWh/a of avoided imports, and thus reduce import dependency by 0.2-1.3% (in volume terms) in 2030, depending on the scenario.

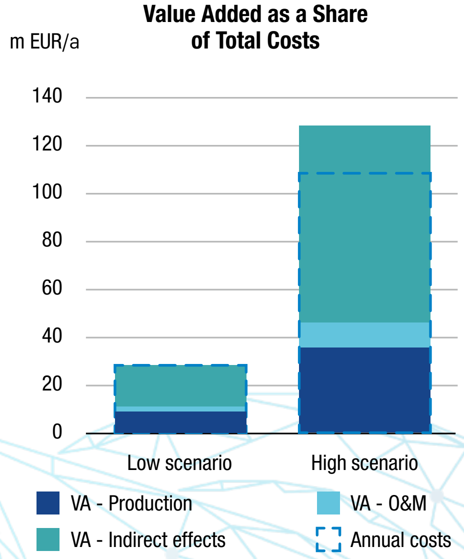


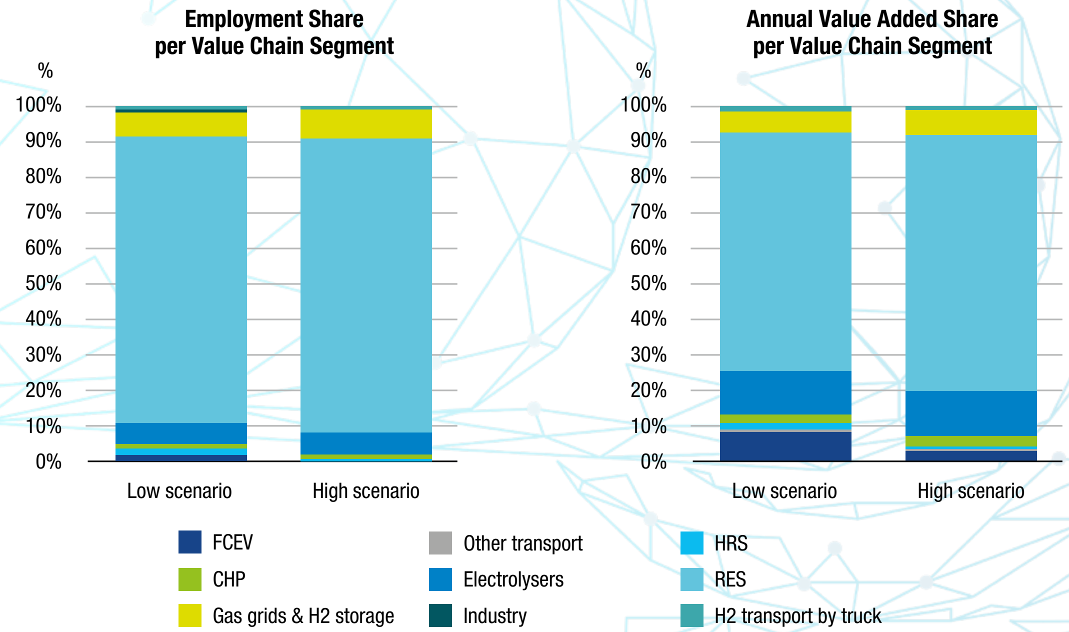
Impact on employment and value added

This analysis shows that in the years 2020-2030 around 7 million EUR can be retained annually in the domestic economy as value added in the low scenario, and almost 50 million EUR in the high scenario (value added is defined here as sum of wages for employees, margins for companies and taxes). If the indirect effects induced by the investment in and operation of hydrogen technologies are also taken into account, around 20 million EUR (low scenario) and almost 130 million EUR (high scenario) of value added can be created in the Lithuanian economy annually, which is equivalent or even higher than the amount of annual investment needed. Most of this value added is expected to be created by building and operating dedicated renewable electricity sources and electrolysers for hydrogen production, and in automotive industry.

The hydrogen-related expenditures in 2020-2030 are estimated to generate employment of 180 – 1 200 direct jobs (in production and operations & maintenance) and contribute to a further 400 – 2 500 indirectly related jobs, depending on the scenario. Most of these jobs are expected to be created by building and operating renewable electricity sources, electrolysers and hydrogen transport infrastructure.







LITHUANIA

Opportunities arising from the inclusion of **Hydrogen Energy Technologies** in the National Energy & Climate Plans

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING