SLOVENIA

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

2

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
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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.

SLOVENIA

Main results and impacts of hydrogen deployment in Slovenia by 2030 in the two scenarios modelled in the present study

Onshore Wind
22 - 60 MW
50 - 140 GWh/a

Solar Photovoltaic
47 - 140 MW
50 - 140 GWh/a

Electrolysers
23 - 65 MW
61 - 180 GWh_{H2}/a

POWER
0.1 - 1 GWh/a

TRANSPORT
56 - 128 GWh/a

BUILDINGS
1 - 10 GWh/a

INDUSTRY
3 - 33 GWh/a

10 - 30
Buses

1 - 4
Trains

12 - 25
Refuelling Stations

350 - 810
Trucks

6 300 - 12 600
Cars

30 - 330 GWh/a
Electricity Produced

1 - 9 GWh/a
into Synthetic Fuels

70 - 300
Micro-CHP units
in buildings

0 - 1
Commercial-scale
CHP installations

3 -33 GWh/a
Industrial energy demand

12 - 31
m EUR/a

Value Added
in the domestic economy

Value Added as Share of Annual Costs

New Jobs
270 - 690

Emissions avoided
33 - 78 kt CO_2/a

EXECUTIVE SUMMARY

Slovenia's commitment for hydrogen deployment according to its NECP

The first hydrogen refuelling station in Slovenia was commissioned in 2013. The project was co-financed by the European Union and coordinated by the Center of Excellence for Low-Carbon Technologies CONOT[1] (CONOT is the key facilitator of hydrogen projects in Slovenia and serves as a point of reference for Balkan countries). In 2017, the Government of Slovenia communicated about its commitment to stimulate alternative fuels, among which hydrogen, to "stop the sales of new gasoline and diesel motor cars by 2030".[2]

According to Slovenia's NECP, hydrogen can play a role in integrating the production of renewable electricity, strengthening security of gas supply and contributing to reach the decarbonisation targets. Renewable hydrogen can be used to store large amounts of electricity produced during periods of low demand. Slovenia expects by 2030 a final hydrogen consumption of 10 ktoe (116 GWh) in the transport sector, and by 2040 a consumption of 63 ktoe (732 GWh) mainly in the transport, but also progressively in the building and industry sectors.

Slovenia has an enabling environment to address the deployment of renewable hydrogen mainly in the transport sector, given the national organizations (like CONOT) and companies already active in this domain, its commitment to reduce the consumption of fossil fuels, and its involvement in the Green Hydrogen @ Blue Danube[3] and the Zero Emission Urban Delivery @ Rainbow UnHycorn[4] potential IPCEI projects. Slovenia was not involved in the HyLaw[5] project, but, given its commitment to address the regulatory and non-regulatory barriers to the deployment of hydrogen, could carry out a similar assessment to identify those specific barriers in order to address them.

The scenario assessment shows substantial potential benefits of hydrogen deployment in Slovenia 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 Slovenia, a limited development of hydrogen demand is assumed in the considered scenarios in **transport**, especially for passenger cars, buses and trucks, and to a limited extent in aviation (through hydrogen-based liquid fuels or PtL)[6]. The development of green hydrogen demand in the scenarios in **industry** is assumed only for industrial process heat.
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 in the Low scenario a limited demand of hydrogen by 2030 but would have a stronger demand in the High scenario.

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 0.2 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 its NECP, Slovenia estimates an installed capacity in 2030 of 0.15 GW in onshore wind and 0.5 GW in solar PV, generating over 2 TWh of renewable electricity in 2030. The technical potential for renewable electricity production in Slovenia seems however significantly higher[7]. 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 17 and 41 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. According to the European EUCO3232.5 scenario[8], the Slovenian GHG emissions should be reduced by 4 Mt CO_2 in 2030, compared to 2015. In the scenarios considered, the deployment of hydrogen could contribute 33 – 78 kt CO_2 to this goal, which is equivalent to 1% - 2% of the required emission reduction.

[1] *http://www.conot.si/eng/*
[2] *https://balkangreenenergynews.com/strategy-of-government-of-slovenia-aims-ban-new-gasoline-diesel-cars/*
[3] *https://static1.squarespace.com/static/5d3f0387728026000121b2a2/t/5d9b5e81e73c03421d1dd837/1570463369453/Green+HH2+Blue+Danube+poster_print.pdf*
[4] *https://static1.squarespace.com/static/5d3f0387728026000121b2a2/t/5d9b5ee7f5229f74dc24aa73/1570463472420/Rainbow+Unicorn+poster_print.pdf*
[5] *https://www.hylaw.eu/about-hylaw*
[6] *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.*
[7] *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).*
[8] *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 SLOVENIA

According to Slovenia's NECP, hydrogen can play a role in integrating the production of renewable electricity, strengthening security of gas supply and contributing to reach the decarbonisation targets. Renewable hydrogen can be used to store large amounts of electricity produced during periods of low demand.

Slovenia considers decarbonising its gas supply by blending renewable hydrogen into its natural gas network. According to the NECP, renewable hydrogen is considered as an alternative to conventional fossil fuels; Slovenia estimates that by 2040 around 7% of its fuel consumption could be provided by hydrogen, especially in the transport sector.

According to its NECP, Slovenia will take into account the recommendations of the European Commission and ENTSOG to gradually replace natural gas by renewable gases, such as synthetic gas (SNG), hydrogen and biomethane. To date, Slovenia imports 100% of its gas demand, there is no production of biogas, hydrogen or synthetic gas. Therefore, Slovenia will support the implementation of pilot projects for the production of hydrogen from renewable electricity and expects that, by 2030, about 10% of the national gas consumption would come from renewable sources (biomethane, hydrogen and/or synthetic methane - from hydrogen methanation).

Slovenia plans to establish the appropriate technical and regulatory conditions (including safety) and incentives to facilitate the decarbonisation of the natural gas supply and its replacement by alternative gases from renewable origin, to feed in hydrogen in the gas system and to use it as an alternative road fuel. Slovenia will analyse and determine the technical threshold and specifications for hydrogen blending in the gas infrastructure.

Slovenia plans to develop a market to incentivise the substitution of fossil gas by renewable gases. Those gases will be produced in Slovenia or imported using guarantees of origin. Hydrogen generation is expected to be mainly from renewable sources, in particular from 'excess' electricity supply.

Hydrogen may serve as a link between the electricity, heating and cooling and gas sectors, supporting the integration of higher volumes of variable renewable electricity in the system, enhancing system flexibility, while decarbonising the gas sector and increasing security of gas supply. To this end, Slovenia plans to install dedicated capacity to convert renewable electricity (including electricity produced when supply exceeds demand) into renewable gases (through 'power-to-gas'). Hydrogen is considered appropriate for seasonal storage of renewable energy, but also for short term storage to provide ancillary services to the electricity system (e.g. balancing). Slovenia considers the gas network as one of the potential ways to store hydrogen.

Slovenia intends to focus its research and development activities, among others, to further analyse the impact of blending renewable gases into the natural gas infrastructure on the gas pipeline network and on the different types of end-users, and to demonstrate sector coupling at scale.

According to its NECP, Slovenia intends to enable the integration of hydrogen in its energy and mobility systems. It expects by 2030 a final hydrogen consumption of 10 ktoe (116 GWh) in the transport sector, and by 2040 a consumption of 63 ktoe (732 GWh) mainly in the transport, but also progressively in the building and industry sectors.

OPPORTUNITY ASSESSMENT

Hydrogen production potential & its role in energy system flexibility

The technical variable renewable electricity production potential in Slovenia is higher than the expected electricity demand in 2030, which creates an opportunity to utilize this potential to install additional renewable electricity generation capacity that can be used to produce hydrogen via electrolysis. According to the NECP, Slovenia would by 2030 only use 13% of its technical potential in renewable electricity generation, so there is a great margin for building up these dedicated renewable electricity sources.

The opportunity to use power-to-hydrogen conversion as flexibility provider to the electricity system is by 2030 still rather limited, as the Slovenian energy system is expected to have in 2030 a lower installed capacity of variable renewable electricity generation than the average load. This opportunity is further affected by the very high electricity interconnection capacity, including with the much larger Italian energy market.

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	Readiness for CO_2 storage
				based on NECP	
16	108%	2.11	13%	38%	Low

Slovenia 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

The publicly available information on the natural gas network infrastructure does not provide indications about the technical and economic feasibility for using it for hydrogen. As foreseen in the NECP, Slovenia will assess and determine the technical specifications and thresholds to blend renewable hydrogen into the gas infrastructure and is expected to also assess the cost of converting the infrastructure. Considering the low density of the gas grid, potential conversion or adaptation of some sections of the network would have to be planned properly in order to focus on areas where it is more relevant and cost effective.

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)
N.A	0.4	0	NO
MS range 16%-99%			

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

Current and potential gas & hydrogen demand

Significant opportunities for the deployment of renewable or low-carbon hydrogen seem to exist in Slovenia, in particular in industry and the transport sector. In the transport sector, the largest potential for hydrogen and derived fuels seems to be in the decarbonisation of road transport and international shipping. In industry, hydrogen deployment is expected to contribute primarily to the decarbonisation of the fossil gas supply and on the medium to long term also to the generation of high-temperature process heat. In the built environment, hydrogen could contribute to the decarbonisation of existing gas use, already on the short term. On the medium to long term, hydrogen is one of the low-carbon energy carriers that can contribute to the decarbonisation of the parts of the heat demand that are currently covered by oil-fired boilers or fossil-based district heating.

Opportunities for hydrogen demand in industry

In Slovenian industry the opportunities for hydrogen deployment are mostly related to the replacement of natural gas use and the decarbonisation of high-temperature heat production. Natural gas accounts for one third of the industrial energy use in Slovenia and deployment of renewable and low-carbon hydrogen can decarbonise the gas supply and thereby reduce the GHG emissions from gas use in industry. Furthermore, 30% of the energy use in Slovenia's industry is used for the production of high-temperature process heat. Hydrogen is one of the low-emission energy carriers that is well-suited for the generation of heat for such processes. To date, Slovenia does not have industries with major hydrogen-dependent processes.

	Presence of ammonia industry / share of ammonia production capacity in EU28 total	Presence of refineries / Share of Slovenian refineries in total captive hydrogen production by refineries in the EU28	Share of Slovenia 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)
Slovenia	0%	0%	0%	34%	30%
EU	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

In Slovenia there is some potential for the deployment of hydrogen for the generation of heat in the built environment, although this potential seems limited. Natural gas accounts for only 10% of the energy use in the built environment and 15% of the demand for heating. Renewable or low-carbon hydrogen can be deployed to decarbonise this part of the heat demand in Slovenia. Furthermore, almost 20% of the demand for heating is satisfied through the combustion of oil. On the medium to long term hydrogen is one of the low-carbon energy carriers that can decarbonise this segment of the energy demand as well. Lastly, hydrogen can play a role in decarbonising the fuel mix of district heating plants, which is still largely based on fossil fuels. District heating accounts for 10% of the heat demand in Slovenia's built environment.

	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)
Slovenia	10%	80%	3%
EU	Average 34% MS range 0% - 60%	Average 74% MS range 41% - 82%	Average 3% MS range 0% - 46%

Opportunities for hydrogen demand in transport

According to the assessment, Slovenia has significant opportunities relating to the deployment of hydrogen in the transport sector. Like in all EU countries, road transport is still heavily reliant on the use of fossil fuels and hydrogen is one of the solutions that can contribute to the decarbonisation of this subsector. Around 30% of the energy use in this sector is consumed by trucks, buses and light commercial vehicles (e.g. vans). Since electrification of this segment of road transport remains challenging, hydrogen can play a substantial role to decarbonise this part of Slovenia's road transport. Next to this, diesel trains still account for around a third of the energy use in the Slovenian rail sector. A switch to hydrogen trains is one of the solutions to reduce the GHG emissions from rail transport. Furthermore, hydrogen could play a role in the decarbonisation of the energy mix in the international shipping sector, of which the energy use accounts for an equivalent of 8% of the total transport demand. Therefore, to fully decarbonise the transport sector, a switch to low-carbon fuels in the shipping sector is needed. Hydrogen and derived fuels are amongst the most feasible solutions for this purpose. On the medium to long term, these energy carriers can also be used to decarbonise the aviation sector, although this sector only has a limited share in the Slovenian transport energy demand today, but this share is expected to rise significantly in the coming decades.

	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
Slovenia	29% (6 280 GWh)	33% (109 GWh)	0.0% (0 GWh)	8.3% (1 793 GWh)	1% (307 GWh)	98% (20 651 GWh)
EU	Average 32% MS range 18%-48%	Average 30% MS range 0%-95%	Average 2% MS range 0%-10%	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 shows an increasing interest in Slovenia for hydrogen produced from renewable electricity, to be blended with natural gas for use in different sectors, especially for transport, with concrete targets by 2030 and beyond.

However, Slovenia could take further action to improve the enabling environment towards renewable hydrogen. So far, Slovenia has not set up a comprehensive framework for the deployment and use of renewable hydrogen, and only few measures to address the regulatory and non-regulatory barriers are mentioned in its NECP.

Given its large potential for renewable hydrogen production, Slovenia could consider renewable hydrogen as a key carrier within its energy policy to address the decarbonisation challenges in all energy end use sectors. To this end, Slovenia should continue its efforts to properly integrate hydrogen into the electricity and gas systems, in cooperation with neighbouring countries and taking into account the initiatives and policies at EU level.

In the meantime, Slovenia could support its research centres and industry to carry out hydrogen related research. It would be appropriate 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. CONOT could provide support in structuring such roadmap, in close collaboration with other Balkan countries.

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

The additional policies and measures announced in the NECP, notably in the building and energy sectors, would enable Slovenia to overachieve (by -20%) its non-ETS GHG emission reduction target (ESR target at -15%). From this perspective, the interest to implement new measures focusing on the deployment of hydrogen would remain limited.

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)

Hydrogen is included in the Slovenian National Policy Framework (or NPF set in the context of the alternative fuel infrastructure directive (2014/94/EU)) which comprises specific targets for hydrogen-driven vehicles.

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	
YES	1	1 117 935	
	Total 156	Average 1 677 543	

Existence of (investment on) hydrogen-related projects

There is currently only 1 hydrogen refuelling station in Slovenia, but no hydrogen-related industrial projects. However, Slovenia's NECP announces the support for demonstration projects.

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)
NO	0.0	NO	0

Existence of national tax incentives (CO_2 pricing mechanisms & car taxation)

Slovenia has set up a CO_2 pricing mechanism in 1996 and has introduced carbon related taxation for vehicles, which are key to allow progressively the use of low carbon vehicles (including on hydrogen).

Positive environment

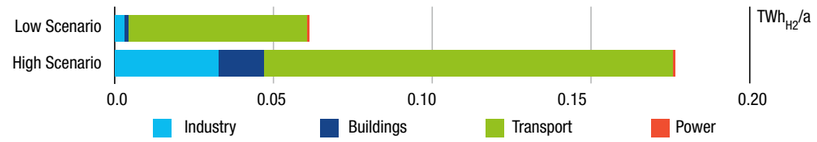
Fossil energy import bill

Like many EU Member States, Slovenia 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 energy import dependence and bill.

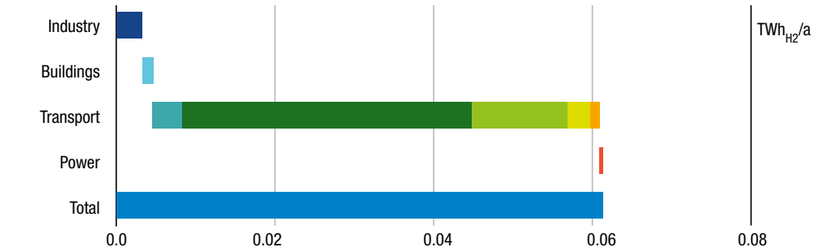
Import bill for natural gas as share of national Gross Value Added	Import bill for all fossil fuels
0.5%	**3.3%**
Average: **0.6%** MS range: 0% - 1.5%	Average: **2%** MS range: 0% - 7%

SCENARIO ASSESSMENT
Estimated renewable/low carbon hydrogen demand for Slovenia 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).

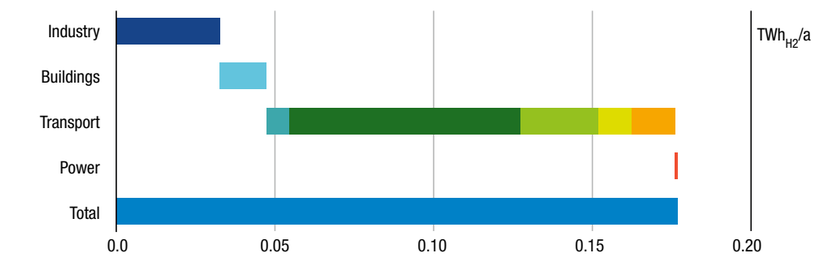


Low scenario

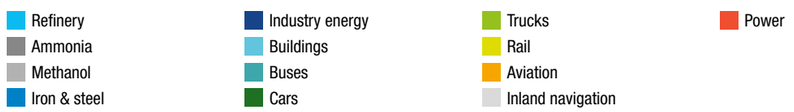


In the low scenario, renewable hydrogen accounts for 0.1% of final total energy demand (i.e. 0.1 out of 51 TWh/a) or 0.9% of final gas demand (7 TWh/a) according to EUCO3232.5.

High scenario



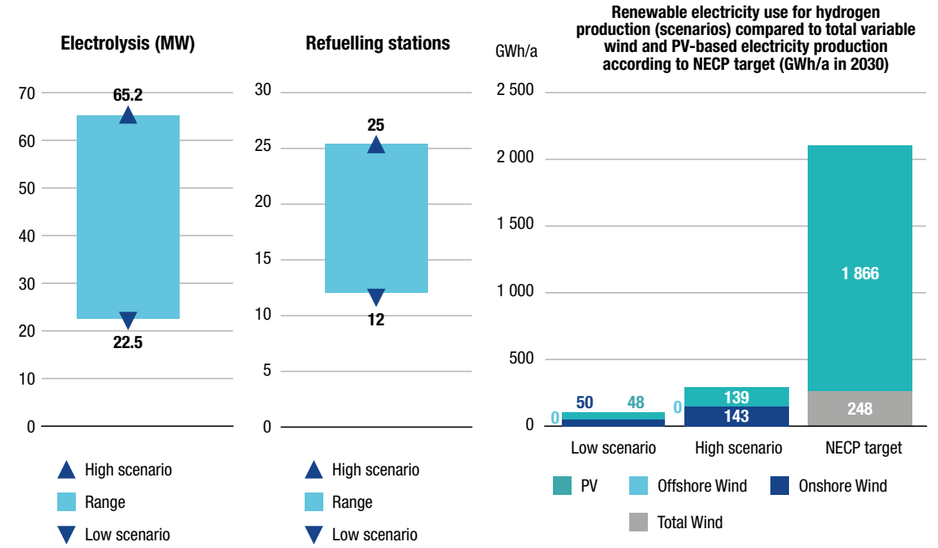
In the high scenario, renewable hydrogen accounts for 0.3% of final total energy demand (i.e. 0.2 out of 51 TWh/a) or 2.7% of final gas demand (7 TWh/a) according to EUCO3232.5.



Hydrogen generation, infrastructure and end users in Slovenia 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 1.2% of the overall technical renewable power potential in the low scenario and for 3.6% in the high scenario.

End users

End user	Unit	Low scenario	High scenario
Passenger cars	Nº	6 300	12 600
Buses	Nº	10	30
Lorries	Nº	300	700
Heavy duty vehicles	Nº	50	110
Trains	Nº	1	4
Substituted fuel in aviation	GWh/a	1	9
Substituted fuel in navigation	GWh/a	0	0
Micro CHP	Nº	70	290
Large CHP	Nº	0	1
Iron&Steel	% of prod.	0%	0%
Methanol	% of prod.	0%	0%
Ammonia	% of prod.	0%	0%

According to the estimations, the hydrogen refuelling station network will by 2030 encompass between 10-30 stations for 7 000-13 000 fuel cell vehicles on the road.[9]

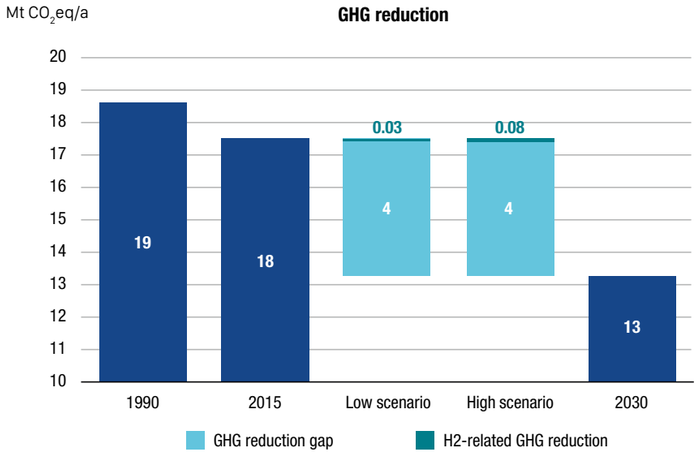
The introduction of 70-290 stationary fuel cells for combined power and heat production is estimated.

[9] *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 Slovenia 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.

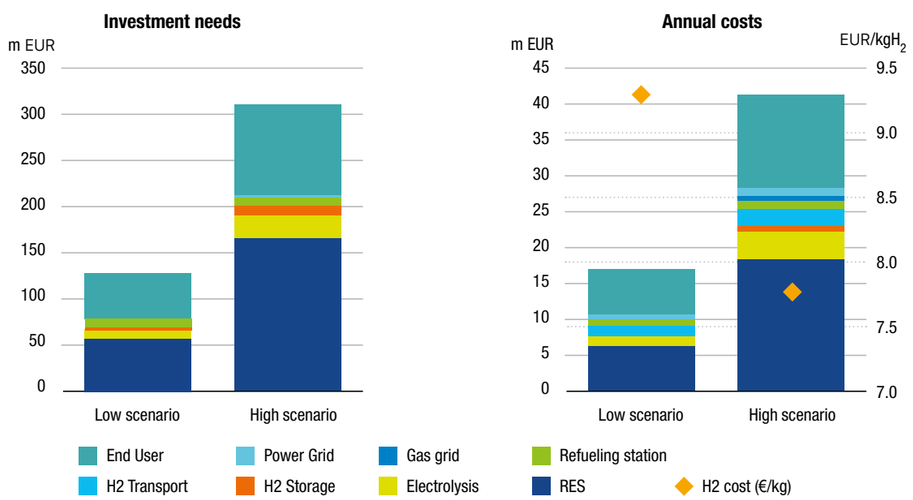
Environmental impact



An additional GHG emission reduction of 0.03-0.08 Mt CO_2 is estimated in 2030 corresponding to 0.8%-1.9% 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 0.1-0.3 billion EUR until 2030, while annual expenditure would amount to 20-40 million EUR (including end user appliances as well as power and gas grids).

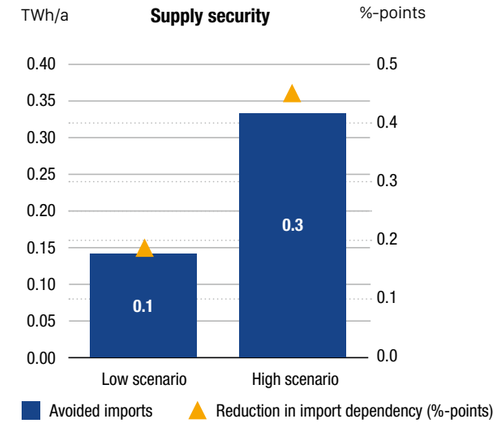


Impact on security of supply, jobs and economy in Slovenia by 2030

Hydrogen contributes to the security of 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

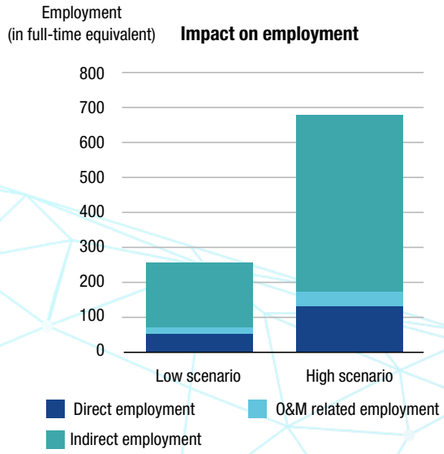
Deployment of renewable hydrogen would lead to 0.1-0.3 TWh/a of avoided imports, and thus reduce import dependency by 0.2-0.5% (in volume terms) in 2030, depending on the scenario.

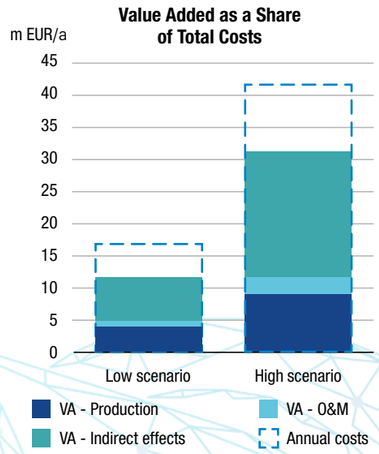


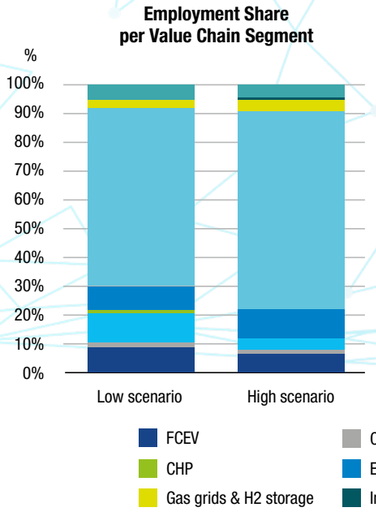
Impact on employment and value added

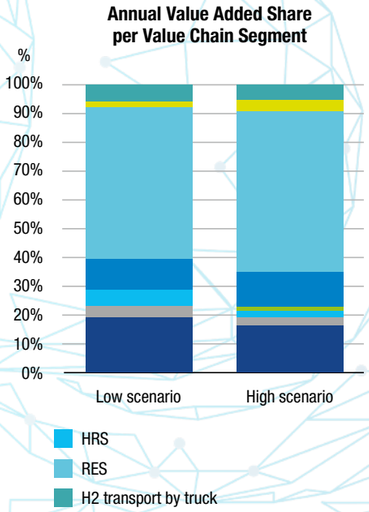
This analysis shows that in the years 2020-2030 around 5 million EUR can be retained annually in the domestic economy as value added in the low scenario, and almost 12 million EUR in the high scenario (value added is defined here as sum of wages for employees, margins for companies and taxes). If the indirect effects induced by the investment in and operation of hydrogen technologies are also taken into account, around 12 million EUR (low scenario) and 12 million EUR (high scenario) of value added can be created in the Slovenian economy annually, which is equivalent to three quarters of the annual amount of investment needed. Most of this value added is expected to be created by building dedicated renewable electricity sources and electrolysers for hydrogen production, and in automotive industry. In the low scenario, a more significant share of value added is expected to be created by building and operating hydrogen refuelling stations and by hydrogen transport in trucks.

The hydrogen-related expenditures in 2020-2030 are estimated to generate employment of 70 - 180 direct jobs (in production and operations & maintenance) and contribute to a further 200 – 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 refuelling stations.









SLOVENIA

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

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

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