MALTA

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

2

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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.

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

MALTA

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

Electrolysers
3 - 27 MW
6 - 48 GWh_{H2}/a

Solar Photovoltaic
7 - 55 MW
9 - 76 GWh/a

TRANSPORT
6 - 48 GWh/a

0 - 10
Buses

1 - 3
Refuelling Stations

700 - 1 400
Cars

0 - 113
Trucks

3 - 29 GWh/a
into Synthetic Fuels

BUILDINGS
0.01 - 0.14 GWh/a

1 - 3
Micro-CHP units
in buildings

1 - 8
m EUR/a

Value Added
in the domestic economy

Value Added as Share of Annual Costs

New Jobs
30 - 220

Emissions avoided
2 - 10 kt CO_2/a

EXECUTIVE SUMMARY

Malta's commitment for hydrogen deployment according to its NECP

According to its NECP, Malta approaches hydrogen from three main angles: gas infrastructure (the pipeline project with Italy is a critical element to secure Malta's energy supply and should allow the injection of green gases), decarbonising the transport sector and producing green hydrogen with domestic renewable electricity (*"Hydrogen is the missing link to the widespread use of renewable energy sources"*). As stated in its NECP, *"Malta believes that the electrification of transport is the solution to achieve a viable and sustainable future transport system. Hydrogen Fuel Cell Technology is expected to power larger electric drive trains used for trucks and buses while Battery Electric Vehicles will power passenger cars".*

Malta is in a positive starting position as it considers hydrogen in the perspective of security of energy supply, renewable energy deployment and transport decarbonisation. Malta will probably be involved in the extension of the H2GO[1] IPCEI project. Malta was not involved in the HyLaw project, but could carry out a similar assessment of its national barriers to the deployment of hydrogen. The Ministry for Transport and Infrastructure together with Transport Malta (dealing with road, aviation and maritime transport) will pursue future technology developments and facilitate demonstration and lighthouse projects[2], considering hydrogen and fuel cells in the development of the National Transport Strategies[3] .

Malta seems to consider hydrogen as a longer-term option. Its NECP does not provide concrete hydrogen targets nor hydrogen specific policies and measures.

The scenario assessment shows substantial potential benefits of hydrogen deployment in Malta 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 Malta, a limited development of hydrogen demand is assumed in **transport**, in particular for passenger cars, buses, trucks and in aviation (through hydrogen-based liquid fuels or PtL)[4]. No development of hydrogen demand is assumed in the considered scenarios in industry.

The **building** sector is expected to have a limited demand of hydrogen by 2030 in the Low scenario but would have a stronger demand in the High scenario.

Hydrogen production

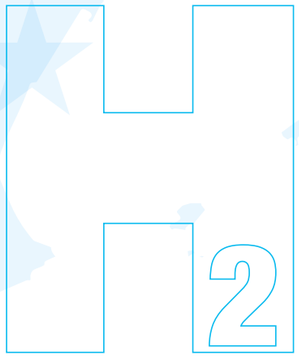
To cover the estimated hydrogen demand, 7 to 55 MW of dedicated renewable electricity capacity would have to be installed to produce green hydrogen via electrolysis. While "surplus" electricity might be available in times of high renewable electricity production, the main share of hydrogen demand will have to be covered by dedicated sources.

In its NECP, Malta estimates an installed capacity in 2030 of 184 MW in solar PV, generating 385 GWh of renewable electricity in 2030. The technical potential for renewable electricity production in Malta 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 in the considered scenarios reach respectively 2 and 12 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[6], the Maltese GHG emissions should be reduced by 400 kt CO_2 in 2030, compared to 2015. In the scenarios considered, the deployment of hydrogen could contribute 2 – 10 kt CO_2 to this goal, which is equivalent to 0.5% - 2.5% of the required emission reduction.

[1] *https://static1.squarespace.com/static/5d3f0387728026000121b2a2/t/5d9b82e03ef63205cf33e4a4/1570472681940/H2Go.pdf*
[2] *https://electromobility.gov.mt/en/Pages/Hydrogen.aspx*
[3] *https://www.transport.gov.mt/strategies/strategies-policies-actions/national-transport-strategies-in-development-1345*
[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 MALTA

Malta's energy strategy strongly focuses on achieving greater security of supply through the diversification of energy sources and suppliers and reducing energy import dependency primarily through the deployment of indigenous RES. Malta considers the Gas Pipeline project with Italy (Sicily) as an important element to secure its energy supply and tap future opportunities such as the supply of biomethane blended with natural gas and possibly also hydrogen. The pipeline will contribute to Malta's long-term decarbonisation strategy and provide the basis for the shift of conventional plants to green gases. This development would contribute to Malta's efforts to increase its renewable energy share which remains limited and should be enhanced taking into account increasing electrification.

Malta's National Electromobility Action Plan (MNEAP) is being updated to reflect the National Transport Strategy and National Operational Transport Master Plan, including a new action plan up to 2025 and a long-term strategy (2050). In 2019, the Ministry for Transport, Infrastructure and Capital Projects commissioned a study to evaluate the feasibility of CNG and LNG in road transportation. Meanwhile, Transport Malta is working on a pilot project to demonstrate hydrogen propulsion.

Malta believes that the electrification of transport is the solution to achieve a viable and sustainable future transport system. Hydrogen Fuel Cell Technology is expected to power larger electric drive trains used for trucks and buses while Battery Electric Systems will power passenger cars. In this regard, the Ministry for Transport and Infrastructure together with Transport Malta will pursue future technology developments and facilitate demonstration and lighthouse projects. The Malta National Hydrogen and Fuel Cell Technology Innovation Programme (MNHFCTIP) will be part of the Malta National Electromobility Action Plan which will step up its efforts to promote battery and all-electric drive technologies. The Maltese authorities will also follow technological developments in Hydrogen Fuel Cell Technology applications for the maritime sector.

ERDF funds were accessed by Maltese researchers through Interreg Mediterranean and Interreg Europe 2014-2020, like the project SMART-HY-AWARE, which addresses the transition to a low-carbon transport sector with special focus on hydrogen-electric mobility.

OPPORTUNITY ASSESSMENT

Hydrogen production potential & its role in energy system flexibility

Since the estimated technical potential of variable renewable electricity production in Malta is about three times higher than its forecasted electricity demand in 2030, there is an opportunity to develop production of hydrogen by electrolysis, using electricity from new dedicated solar PV or wind parks and from potential 'surpluses' of renewable electricity generation. According to the NECP, Malta would only use 6% of its technical potential in variable renewable electricity generation by 2030, so there is a great margin for building up dedicated renewable electricity sources for hydrogen production via electrolysis.

There is an opportunity to use power-to-hydrogen conversion (and storage) as a flexibility provider, although the installed capacity of variable renewable electricity generation would in 2030 still be lower than its average load. The need for system flexibility is reinforced by Malta being a fairly isolated island energy system with no large-scale energy storage capacity.

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
7	217%	0.39	6%	70% based on NECP	N.A.

Malta has limited readiness for deployment of CCS. No evidence of activity or plans in this technology was found.

Energy infrastructure

In view of enhancing its energy supply security and decarbonising its energy supply, Malta could consider producing hydrogen based on renewable electricity and transporting it by road to end-users. As Malta has no gas distribution network, there is no opportunity for using existing gas infrastructure to transport and distribute hydrogen. However, depending on its plan to build a pipeline to Italy, this infrastructure could also ensure the possibility to inject hydrogen, and could in the long term be used as a dedicated hydrogen pipeline.

Technical and economic feasibility of converting gas distribution networks to hydrogen (share of polyethylene pipelines in distribution grid)	Existing salt cavern natural gas storage sites (TWh)	Suitable geological formations (potential for future hydrogen storage)
N.A.	0	NO
MS range 16%-99%		

There are no salt cavern natural gas storage sites in Malta that could be used for hydrogen, nor underground salt layers that could provide suitable storage opportunities for hydrogen.

Current and potential gas & hydrogen demand

In Malta, the short-term opportunities for the deployment of decarbonised hydrogen are more limited than in most other EU Member States, since the country cannot build on existing gas infrastructure. Next to that, the industrial energy demand and demand for heating in the built environment are relatively low. However, on the medium to long term, hydrogen might be utilised as one of the solutions to decarbonise the part of the heat demand in the built environment that is currently based on oil combustion and it might play a role in satisfying the increasing demand for cooling. In the transport sector, the largest opportunity for the deployment of hydrogen and derived fuels might be the international shipping sector, which consumes 10 times more energy than the entire domestic transport sector on the island. Lastly, hydrogen could play a role in the decarbonisation of some specific applications in road transport, for example trucks and buses.

Opportunities for hydrogen demand in industry

In Malta, the deployment potential for hydrogen in industry seems rather limited. First of all, industry accounts for only 9% of the country's energy demand. Currently, there is no use of natural gas in the industry and there are no industrial enterprises with existing hydrogen use. Next to this, as the demand for high-temperature process heat is very low, electrification would be a suitable option for most applications. However, oil still accounts for 30% of the energy mix in Malta's industry, so hydrogen could be deployed as one of the solutions to decarbonise this part of the industrial energy demand on the medium to long term.

Presence of ammonia industry / share of ammonia production capacity in EU28 total	Presence of refineries / Share of Maltese refineries in total captive hydrogen production by refineries in the EU28	Share of Malta 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)
0%	**0%**	**0%**	**0%**	**9%**
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 share of natural gas in the final energy use in households and the service sector in Malta is very low. As a consequence, the short-term potential for the deployment of hydrogen for heating applications in the built environment seems limited. However, 55% of the demand for heating is supplied by oil-fired boilers. On the medium to long term, hydrogen could complement electrification as a solution to decarbonise this part of the demand for heating, which will require a system for distributing hydrogen (e.g. by trucks). On this time frame, hydrogen might also play a role in the growing demand for space cooling. Today, space cooling already accounts for one third of Malta's final energy demand in households and services.

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)
0%	**42%**	**34%**
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 Malta there is an opportunity for the deployment of hydrogen in the shipping sector. Energy use for international shipping is 10 times larger than the country's domestic energy demand in transport. Hydrogen is a suitable solution to decarbonise this strongly fossil fuel dependent sector. Although international shipping is 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. Like in most countries, road transport in Malta is also still heavily reliant on fossil fuels. Electrification of this sector is a suitable decarbonisation strategy for Malta, as the travelling distances on the island are rather limited. For some specific applications, like trucks and buses, hydrogen could be an interesting alternative to electrification.

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[7]	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
31% (535 GWh)	No fossil-dependent rail transport (0 GWh)	**6.4%** (155 GWh)	**1 011%** (24 535 GWh)	**6%** (1 776 GWh)	**95%** (2 163 GWh)
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%

[7] *Inland shipping includes all shipping from one national port to another national port.*

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

The assessment shows that Malta has not yet set up a comprehensive framework for the deployment and use of hydrogen. It has only considered it in the frame of the gas network pipeline to Italy and in its National Transport Strategy. Therefore, it would be appropriate that Malta properly considers hydrogen within its energy policy to address the decarbonisation challenges in all energy end-use sectors, by adopting a hydrogen roadmap and taking into account the initiatives and policies at EU level.

Considering its huge renewable energy potential, Malta could even assess the opportunity to produce hydrogen for exportation, e.g. to Italy via the planned gas pipeline. Malta could consider setting up a specific association for hydrogen to provide support in structuring such strategic work.

In the meantime, Malta could set up and participate in dedicated hydrogen related research and facilitate the implementation of pilot and demonstration projects, which can contribute to paving the way for the use of renewable hydrogen as a means to achieve deep decarbonization.

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

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

Malta indicates in its NECP that it will not be able to meet its non-ETS GHG reduction target domestically because of limited mitigation potential and high mitigation costs. Nevertheless, unexploited emission reduction potentials remain in the transport sector, which forms the largest source of non-ETS GHG emissions, and in buildings. Therefore, the deployment and use of renewable hydrogen could be an interesting option to contribute filling in the gap.

	Positive environment
Existence of (active) hydrogen national association	✗

Current and planned hydrogen refuelling infrastructure for the transport sector

Alternative fuels infrastructure directive (2014/94/EU)

In 2019, the Ministry for Transport, Infrastructure and Capital Projects commissioned a study to evaluate the feasibility of CNG and LNG in road transport, in line with Directive 2014/94 on the Deployment of Alternative Fuels, and the results are now being analysed. Transport Malta is at present working on a pilot project to demonstrate hydrogen propulsion.

Inclusion of hydrogen in national plans for the deployment of alternative fuels infrastructure (2014/94/EU)	Existence of hydrogen refuelling stations (2019)
NPF not received	**0**

Existence of (investment on) hydrogen-related projects

The Ministry for Transport together with Transport Malta will pursue future technology developments and facilitate demonstration and lighthouse projects[8], considering hydrogen and fuel cells in the development of the National Transport Strategies.

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)
Planned	**0**	**NO**	**0**

[8] *https://electromobility.gov.mt/en/Pages/Hydrogen.aspx*

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

Positive environment

Fossil energy import bill

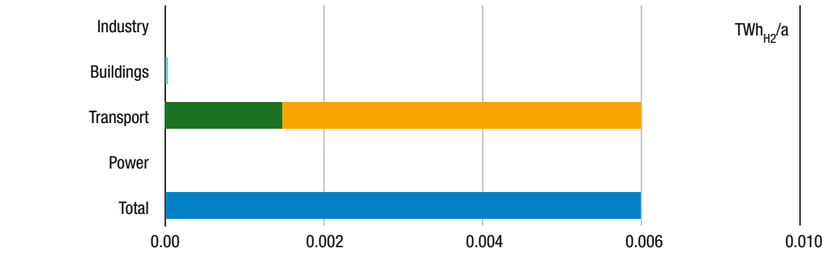
Like many EU Member States, Malta is strongly dependent on imports for its oil and natural gas consumption. Switching from imported fossil fuels to nationally produced hydrogen could contribute to reducing the import dependence and bill.

	Import bill for natural gas as share of national Gross Value Added	Import bill for all fossil fuels
	1.0%	**6.6%**
	Average: **0.6%** MS range: 0% - 1.5%	Average: **2%** MS range: 0% - 7%

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

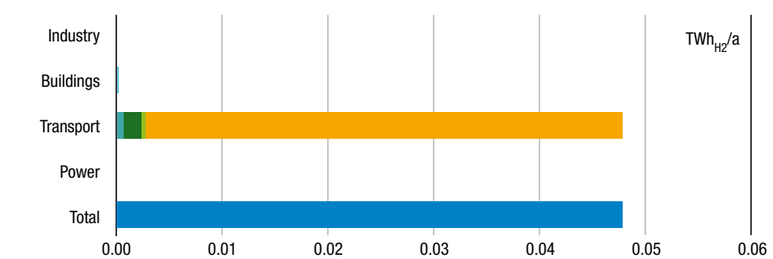
Hydrogen demand in the year 2030 has been estimated in a low and a high scenario covering the range of uncertainty. Today, conventional hydrogen mainly used in industry is produced from fossil fuels (e.g. through steam methane reforming) or is a by-product from other chemical processes. Both scenarios 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

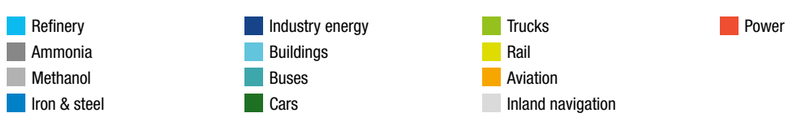


In the low scenario, renewable hydrogen accounts for 0.1% of final total energy demand (i.e. 0.01 out of 6 TWh/a) or 51.2% of final gas demand (0.01 TWh/a) according to EUCO3232.5.

High scenario



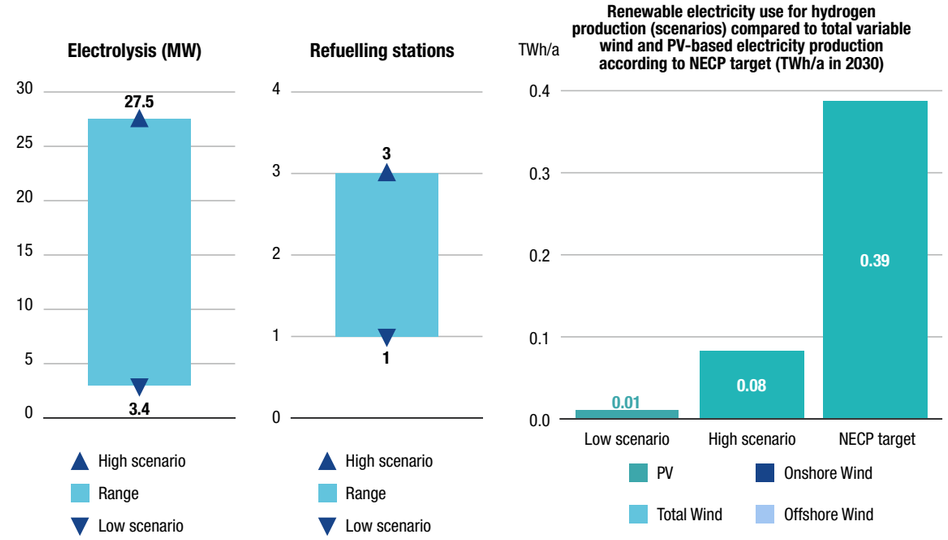
In the high scenario, renewable hydrogen accounts for 0.8% of final total energy demand (i.e. 0.05 out of 6 TWh/a) and exceeds final gas demand (0.01 TWh/a) according to EUCO3232.5 by a factor of 4.



Hydrogen generation, infrastructure and end users in Malta 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 1.1% of the overall technical renewable power potential in the low scenario and for 8.5% in the high scenario.

End users

End user	Unit	Low scenario	High scenario
Passenger cars	Nº	700	1 400
Buses	Nº	0	10
Lorries	Nº	0	110
Heavy duty vehicles	Nº	0	3
Trains	Nº	0	0
Substituted fuel in aviation	GWh/a	3	29
Substituted fuel in navigation	GWh/a	0	0
Micro CHP	Nº	1	3
Large CHP	Nº	0	0
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 1-3 stations for 700-1 500 fuel cell vehicles on the road[8].

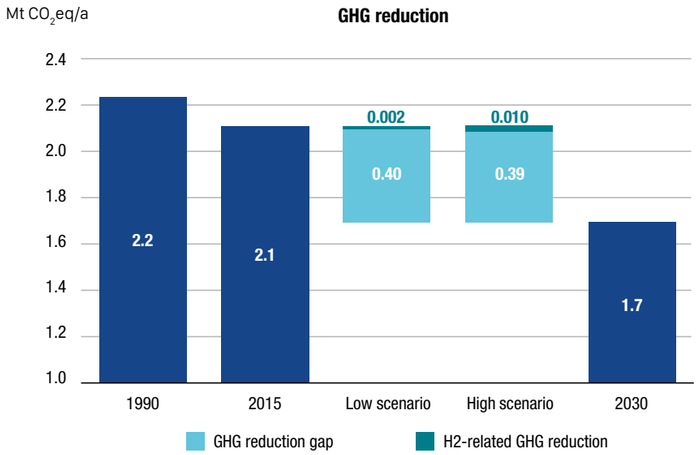
Finally, the introduction of 1-3 stationary fuel cells for combined power and heat production is estimated.

[8] *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 Malta 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.

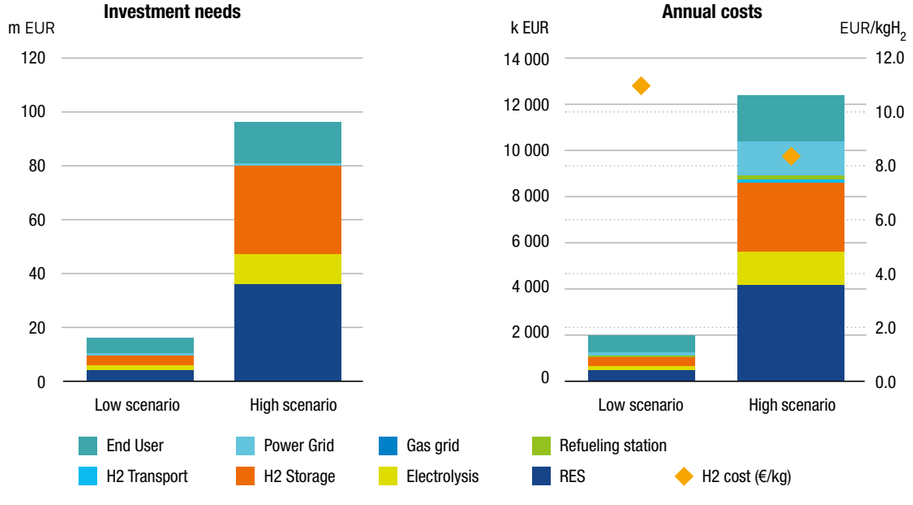
Environmental impact



An additional GHG emission reduction of 2-10 kt CO_2 is estimated in 2030 corresponding to 0.4%-2.5% 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 20-90 billion EUR until 2030, while annual expenditure would amount to 2-12 million EUR (including end user appliances as well as power and gas grids).

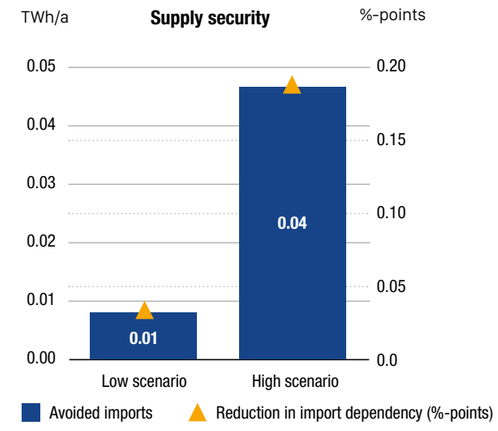


Impact on security of supply, jobs and economy in Malta by 2030

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

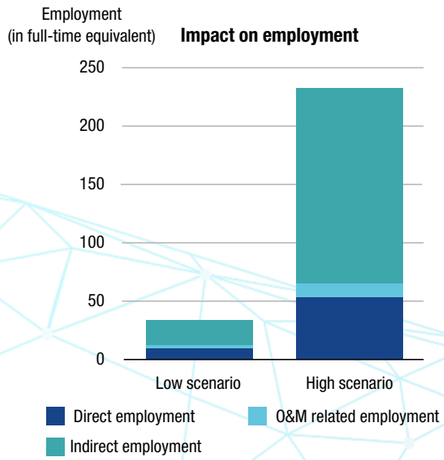
Deployment of renewable hydrogen would lead to 0.01-0.04 TWh/a of avoided imports, and thus reduce import dependency by 0.03-0.2% (in volume terms) in 2030, depending on the scenario.

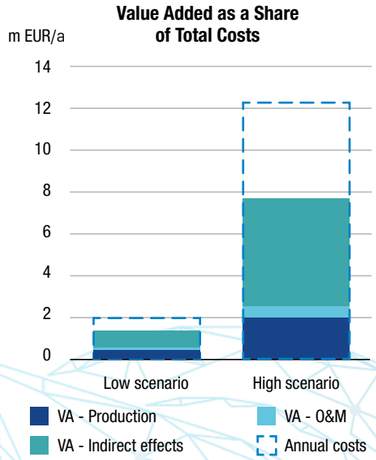


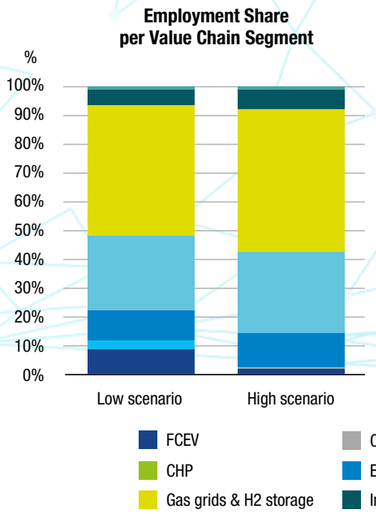
Impact on employment and value added

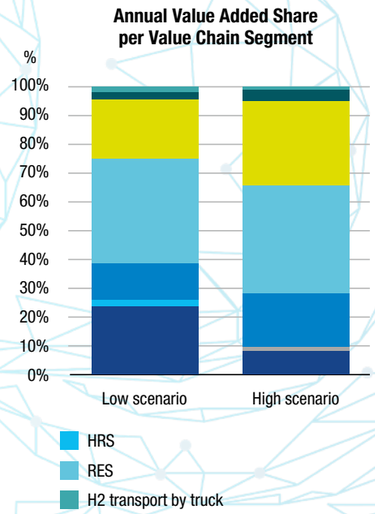
This analysis shows that in the years 2020-2030 more than 0.5 million EUR can be retained annually in the domestic economy as value added in the low scenario, and almost 3 million EUR in the high scenario (value added is defined here as sum of wages for employees, margins for companies and taxes). If the indirect effects induced by the investment in and operation of hydrogen technologies are also taken into account, around 1.2 million EUR (low scenario) and almost 8.5 million EUR (high scenario) of value added can be created in the Maltese economy annually, which is around two thirds of the expected costs. Most of this value added is expected to be created by investments in and operation of renewable electricity generation capacity, followed by investment in hydrogen transport infrastructure, operation of electrolysis capacity and the investment in fuel cell cars.

The hydrogen-related expenditures in 2020-2030 are estimated to generate employment of 10 - 60 direct jobs (in production and operations & maintenance) and contribute to a further 25 - 160 indirectly related jobs, depending on the scenario. Most of these jobs are expected to be created by deploying and operating fuel cell eletric vehicles and in the production of renewable electricity and electrolysers. In the high scenario, a more significant job creation is expected to occur in the CHP industry.









MALTA

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

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

2