

Distribution of chains, bounds and regional development of infrastructure: HyWays storyline for Greece, high penetration only

This document aims to present the Greek storyline as derived from the MS workshops. The general concept which was discussed is further processed with relation to estimations of the hydrogen penetration in the different regions and with respect to local availability of sources.

1. Rough storyline based on MS workshops:

- Renewable Energy Source is aiming to play a significant role at the beginning and the end of the development of the hydrogen infrastructure development in Greece
- Lignite, the only domestic energy source will have a small share of the total hydrogen production
- Natural gas will be of significant importance for the middle term period.
- Greek island is expected to play a crucial role for the penetration of hydrogen in Greece. Remote areas of high electricity cost up to now due to the non-interconnected electricity supply system in conjunction with the high RES potentials is expected to be first lighthouse projects in Greece
- The environmental constraints especially dealing with the Athens region is expected to be a driver for the penetration of hydrogen transport to Greece.
- Mixing H₂ in natural gas pipelines is foreseen in the early stages of hydrogen utilisation
- There is no existing hydrogen infrastructure
- Electricity grid will be used for the transmission of RES produced electricity to electrolyzers within Greece

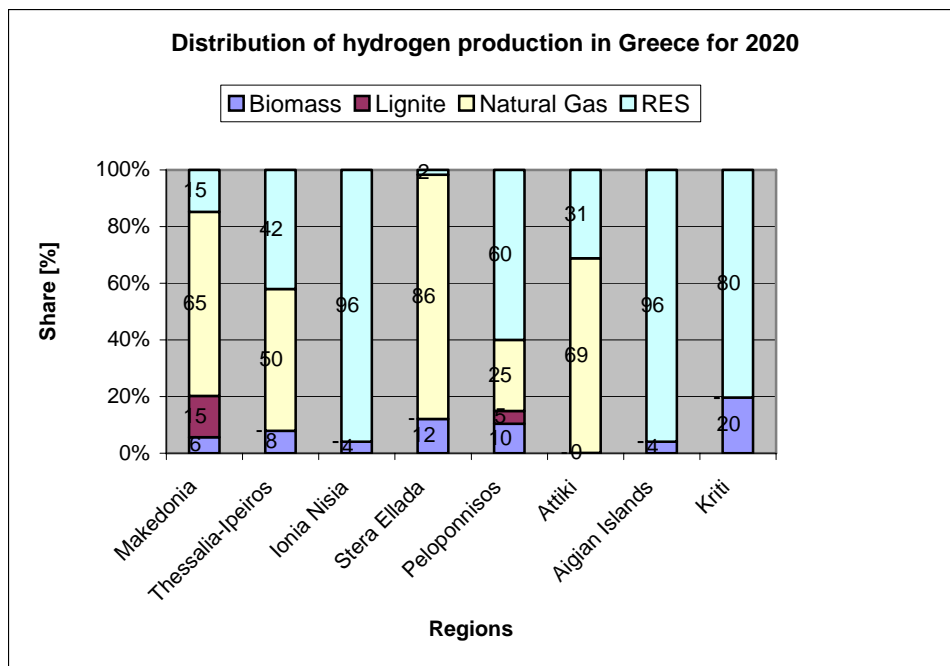
Until 2010

The case of a Greek island supported by hydrogen is expected to be implemented in Greece. Wind parks and electrolyzers will be used for the local supply of hydrogen where stationary applications will be used as well some transport cases are considered.

Transport demo applications in big cities are also expected to be developed in that period.

2010 – 2020

Natural gas will have a critical role in the production of Hydrogen and central production of H₂ is the main option reaching 82% of the total production. Taking into account a production of hydrogen of nearly 1.5 TWh /annum, 40% will be needed for covering the demand of Athens/Attiki region. Macedonia will consume 26% while 10% will be supplied to the Thessalia-Ipeiros region. Central Greece will contribute to 9%, while Peloponnese is expected to consume 4% in which magnitude will be the consumption of Aegean Islands as well as Crete. A 2% remaining is representing Ionian Islands.



SMR will be installed in Athens, Thessaloniki and Larissa while the cases of Kavala and Thiva should be considered as additional options for covering the hydrogen demand, pending on economic figures of alternative supply options of Macedonia, Central Greece and Peloponnesse.

Solid fuels utilization will be located in the existing lignite mines areas, namely Kozani-Ptolemais in the northern part of Greece and Megalopolis in the center of Peloponnesse devoted to the coverage of the local demand.

Natural Gas contribute to 59% of hydrogen production, RES to 32%, biomass represents up to 5% while Lignite is the remaining 4%.

The proposed boundaries for the hydrogen production are :

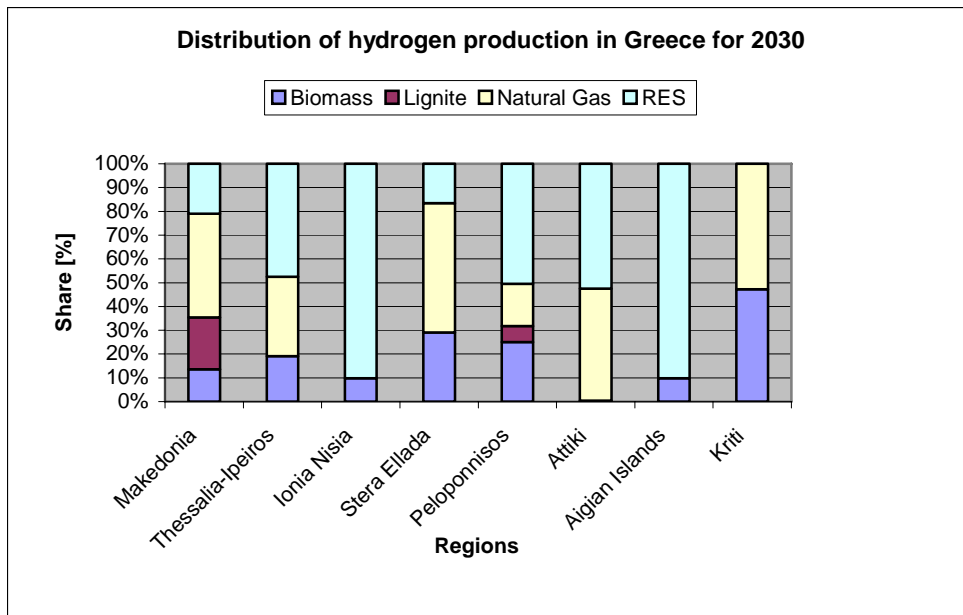
RES	Lignite	Biomass	Total
<5.2%	<0.9%	<2.0%	8.1%

2020 - 2030

In that period decentralised options are increased by 55% reaching an overall of 28% of the total hydrogen production in Greece, which is estimated, to nearly 9.5 TWh per annum.

Natural gas has the significant role representing to 42% of the total production, while RES are almost equal share with a contribution of 40%. Electricity grid is used for the advanced use of RES electricity production in high potential areas and final use in electrolysers located near the consumption. Biomass represents 5% while Lignite is increased to 6%.

Attiki region is still the main consumer. A homogenized hydrogen distribution among different Greek regions was assumed aiming to a balanced evolution of the Greek peripheral economy. Crete is expected to have the infrastructure in order to utilize Natural gas which will be used also via reforming for local demand hydrogen production.



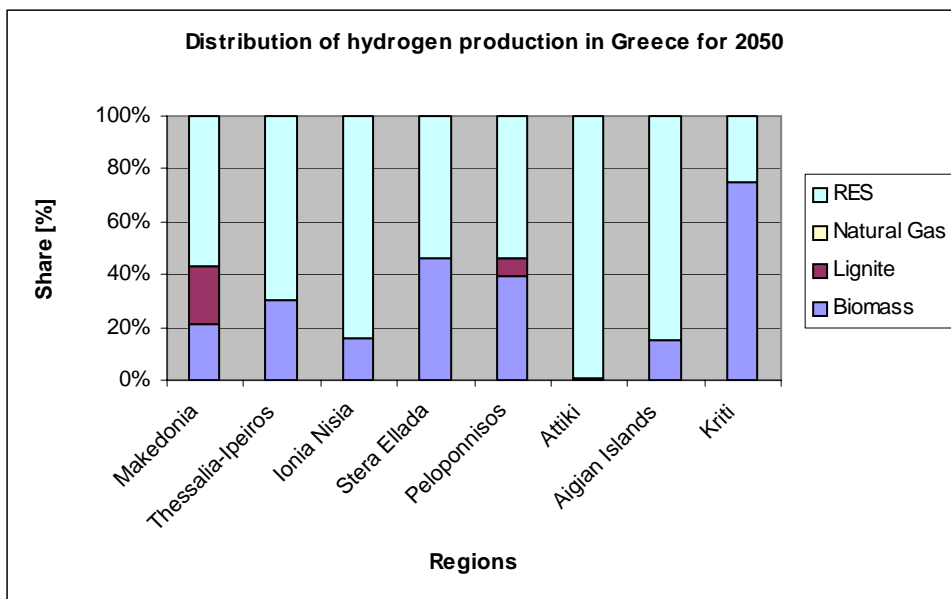
The proposed boundaries for the hydrogen production are :

RES	Lignite	Biomass	Total
<6.5%	<1.4%	<4.8%	12.7%

2030-2050

The final vision for Greece is to develop a hydrogen economy based on local sources namely RES and lignite contributing to the minimisation of energy imports for hydrogen production and maximising the local potentials.

Decentralised options is expected to reach 56% of the total production, while the annual production will increase to more than 30 TWh per annum. RES will contribute to 75%.



CCS options is also considered to be linked with hydrogen production from lignite where the estimated potential for national CO2 storage fields of a total 26.5 mil tones CO2 will be used.

The proposed boundaries for the hydrogen production are :

RES	Lignite	Biomass	Total
<12.3%	<1.4%	<7.6%	21.3%