



*Greening Energy
Market and Finance*

Project website: <http://grenfin.eu>

A Biomethane plant and Green Hydrogen Group 1 & 3





With the support of the
Erasmus+ Programme
of the European Union



Question 1 – Carbon Footprint

Assumptions:

-  HHV 39.37 kWh/kg;
-  100% emissions coming from Electricity and natural gas Consumptions in Sant'Agata Bolognese Plant.



Results:

GHG emissions	gCO ₂ eq/kWh	kgCO ₂ eq/kgH ₂
Reforming with CCS	80	3.1496
Reforming w/o CCS	300	11.811
Electrolysis Grid	780	30.7086
Electrolysis PV	120	4.7244
Electrolysis Wind	25	0.98425
Sant'Agata Biomethane	-	2.64

Grid EI > SMR w/o CCS > SMR with CCS > PV EI > Biomethane SMR > Wind EI





Question 2 – CAPEX and OPEX

Main Inputs:

Hydrogen production in Sant'Agata Bolognese/year [Volume]	16,434,782.61	m ³
Hydrogen production in Sant'Agata bolognese/year [Mass]	1,462,695.65	Kg
Capital expenditure (CAPEX) assumptions: SMR without CCUS	746.2	Euro/KW
Capital expenditure (CAPEX) assumptions: electrolysis	715.04	Euro/KW
Operating expenditure (OPEX) assumptions (as % of CAPEX) SMR without CCS	4.70	%
Operating expenditure (OPEX) assumptions (as % of CAPEX) electrolysis	2.20	%

Results:

ECONOMICS			
Years of operation	0	1	
OpEx biomethane		6,048,000	€
OpEx: other		242,686	€
CapEx	5,163,533		€
TOTAL Opex+Capex (€/year)	5,163,533	6,290,686	€



Question 3 – Incentive for Biomethane SMR

Assumptions:

biomethane cost	€/Nm ³	0.8
biomethane input to steam reforming	Nm ³ _{biomethane} /Nm ³ _{hydrogen}	0.46
hydrogen selling price - baseline value	€/kg	2.5
depreciation years	year	15
taxes	%	27.9
USD-€ exchange rate	€/USD	0.82



Results:

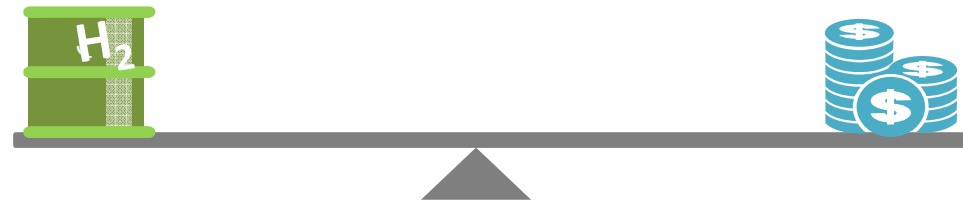
hydrogen selling price - incentive	€/kg	2.28
hydrogen selling price - total	€/kg	4.78
IRR (15 years)	%	8.0



Question 3 – Incentive for Electrolysis

Assumptions:

electricity cost	€/MWh	71
hydrogen selling price - baseline value	€/kg	2.5
depreciation years	year	15
taxes	%	27.9
USD-€ exchange rate	USD/€	0.82



Results:

hydrogen selling price - incentive	€/kg	3.12
hydrogen selling price	€/kg	5.62
IRR (15 years)	%	8.1



Conclusions

Environmental perspective:

- 🌱 Carbon footprint of biomethane plant is four times lower than the standard SMR production
- 🌱 Carbon footprint of EL strictly depends on the electricity source, and the best results came from wind EL. Among all technologies is the better one.

Economical perspective:

- 🌱 We need to incentive the hydrogen price to be competitive
- 🌱 The biomethane SMR is better than the EL



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