



*Greening Energy
Market and Finance*

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

A BIOMETHANE PLANT AND GREEN HYDROGEN

Group 2



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



1. Calculate the carbon footprint as $\text{kgCO}_2\text{eq./kgH}_2$ of the three hydrogen production modes

FINAL RESULTS

Production modes	carbon footprint as $\text{kgCO}_2\text{eq./kgH}_2$
SMR Grey hydrogen	11,811
SMR Biomethane	3,152
Electrolysis (solar PV)	4,724





1. Calculate the carbon footprint as $\text{kgCO}_2\text{eq./kgH}_2$ of the three hydrogen production modes

CALCULATION SMR Grey hydrogen

Production modes	HHV (kWh/kg)	GHG emissions (kgCO ₂ eq/kWh)	carbon footprint as (kgCO ₂ eq./kgH ₂)
SMR Grey hydrogen	39,37	0,3	11,811





1. Calculate the carbon footprint as $\text{kgCO}_2\text{eq./kgH}_2$ of the three hydrogen production modes

INPUT

Step	Emission factors kgCO_2/kWh
electricity	0,483
Natural gas	0,202

Step	Electricity consumption (kWh/m)
PRETREATMENT	90.000
ANAEROBIC DIGESTION	70.000
BIOGAS TO BIOMETHANE	300.000
BIOGAS COMPRESSION	80.000
TOT	540.000

- Conversion factor Nm^3 of H_2 to kg : 0,08988
- Biomethane input to steam reforming (Nm^3 bio / Nm^3 H_2) = 0,46
- Biomethane production (Nm^3 bio/a): 7560000

CALCULATION SMR Biomethane

From	CO_2 emissions (kCO_2/a)
Electricity consumption	3.129.840
Biomethane production	1.527.120
TOT	4.656.960

Units (per year)	Hydrogen produced
Nm^3	16.434.782,61
kg	1.477.158,261

Footprint ($\text{kgCO}_2\text{eq./kgH}_2$)

3,152647975





1. Calculate the carbon footprint as $\text{kgCO}_2\text{eq./kgH}_2$ of the three hydrogen production modes

CALCULATION 3

Production modes	HHV (kWh/kg)	GHG emissions (kgCO ₂ eq/kWh)	carbon footprint as (kgCO ₂ eq./kgH ₂)
Electrolysis (solar PV)	39,37	0,12	4,724





2. Calculate the Capex and the Opex to treat the 100% of the biomethane of Sant'Agata Bolognese

SMR

	biomethane Sm3	Nm3biomethane/Nm3hydrogen	hydrogen Sm3	Hydrogen (kg/year)
STEP 1	7.500.000	0,46	16.304.348	1.465.435

STEP 2

- $CAPEX_{t_0} = \text{Hydrogen produced Kw} * \text{€/Kw} = 14371,2 * 746,2 = \text{€ } 10.72 \text{ bn}$
- $OPEX_{t_0-15}: 4,7\% \text{ of CAPEX} = \text{€ } 0,50/\text{y bn}$
- $OPEX \text{ other}_{t_0-15} = 30\% \text{ of additional personnel costs} = \text{€ } 0,195/\text{y bn}$
- $OPEX \text{ Total} = \text{€ } 0,262/\text{y bn}$



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