Erasmus+ KA2 Knowledge Alliances project

"Greening Energy Market and Finance – GrEnFIn"

AGREEMENT NUMBER: 612408

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Track 1 – Renewable Technologies

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

SECTION 1 – UNDERSTANDING THE GREEN (R)EVOLUTION

Learning Unit 1.1 - "Greening Corporate Strategy"

1. The challenge of Climate Change and the need for a green corporate strategy
   Setting the climate change challenges framework and understanding how to introduce climate targets in corporate strategies

2. Applying the Sustainable Development Goals framework in a corporate strategy

3. Applying the climate change risk management in a corporate strategy
   Increasing risk from climate change and how to factor it within corporate risk management

Learning Unit 1.2 - "Business opportunities and the EU Green Deal"

4. Next Generation EU as business opportunity: main issues, goals and projects of national Recovery Plan (Italy, Poland, Spain, Portugal, Greece).

5. Circular Economy: rethinking business models and value chains

6. Energy transition: the need to pursue both green power and low-carbon gases
   The target for an EU carbon neutrality and the necessary evolution of the energy industry

7. Energy efficiency: the way forward on the consumers' side

Learning Unit 1.3 - "Financial tools in support of the Green (R)evolution"

8. The evolution of Green Finance: from the EU legislation to practice

9. Energy markets: from finance to sustainability
   Gas & Power Markets in EU: from commodity to flexibility

Learning Unit 1.4 - "A Green Infrastructure case study: clean gases"

10. Technological evolutions in the domain of clean gases
    The new technological Trend in hydrogen as energy vector

11. Setting-up a green infrastructure: Hera's biomethane plant

12. Operating and managing a biomethane plant

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SECTION 2 – DEVELOPING SKILLS AND TOOLS TO MASTER THE GREEN (R)EVOLUTION

Learning Unit 2.1 - "Project evaluation: assessing economic and financial fundamentals"
Economic and financial evaluation of investments.

1. Net Present Value, Internal Rate of Return, Cost-Benefit Analysis, Business Planning
2. Cash Flow, debt and short-term equilibrium

Learning Unit 2.2 – "Risk-management tools for a full-blown representation of the project"
Price risk: modelling and evaluation, Var/Par, Long term Var: impact of price volatility on a long-term project.

1. Valutation Hedging Investment Decisions
2. Energy Markets Risk Factors

Learning Unit 2.3 – "Support schemes for Green investments: a tool-kit economic review" with particular reference to the following incentive tools Renewable sources.
Support schemes: Feed in Tariffs, Feed in Premia, Contracts for Differences, (Green) Certificates, Auction mechanisms.

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SECTION 3 - HERA CASE STUDY
"A BIOMETHANE PLANT AND GREEN HYDROGEN"

The energy transition to be effective requires not only renewable energy, typically produced by wind, solar, biomass and hydropower, but also transmission and storage systems, mainly because solar and wind are discontinuous sources. The solar energy is linked to the seasons (more in summer and less in winter) and to the day-night cycle while the wind energy is linked to the presence or less of winds.

To correlate these productions with energy consumption, electrical and thermal, we need a system that allows us to accumulate energy when it is produced, for instance in the warmer months for solar energy, and release le it when we need it most: hydrogen fulfils this function. A key feature of hydrogen is its ability to act as both a source of clean energy and an energy carrier for storage. Hydrogen, in fact, can be transported through existing gas pipelines, in mixture with natural gas and in perspective in dedicated gas pipelines, and it can offer a solution to store energy at a cost ten times lower than batteries (about 20 dollars per megawatt/hour versus 200 $/Mwh).

Currently, hydrogen is produced mainly from fossil methane and used as a raw material in the fertilizer industry and in fuel refining. In this case, the starting material from which hydrogen is obtained is methane (CH_4) through a specific treatment in which hydrogen atoms (H) are separated from carbon atoms (C). This separation process produces two types of emission: a hydrogen flux (also known as "gray hydrogen") and a carbon dioxide flux (CO_2) with climate altering effects. An alternative system to produce hydrogen in a sustainable and not climate altering way ("**green hydrogen**") is one that uses water (H_2O) and renewable electricity to separate hydrogen (H) from oxygen (O), without causing CO_2 emissions.

The purpose of this case study is to consider a third way of producing hydrogen using biomethane as raw material. Biomethane consists of methane atoms that were produced by bacteria through the digestion of biomass (for instance organic waste or agricultural and agro-industrial by-products) and that, due to their origin, do not produce climate altering effects. Also in this case, when biomethane is used for combustion, CO_2 is produced but at the same time it is reabsorbed through the photosynthesis of biomass that allowed the production of biomethane itself.

On this hypothesis we can think of being able to produce hydrogen using as a raw material the biomethane and as a technology the one currently used to produce hydrogen from fossil methane, called **Steam Reforming**.

Therefore, based on previous assumptions we ask you to:

1. Calculate **the carbon footprint of the three hydrogen production modes** described above.
2. Calculate **the Capex** (Capital Expenditure) **and the Opex** (Operating Expenditure) for the realization of a plant suitable to treat the 100% of the biomethane produced at the plant of Sant'Agata Bolognese in Emilia-Romagna, Italy.
3. Define an **incentive to produce green hydrogen** necessary to ensure an IRR (internal rate of return) of the initiative exceeding 8%.

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Greening Energy Market and Finance

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