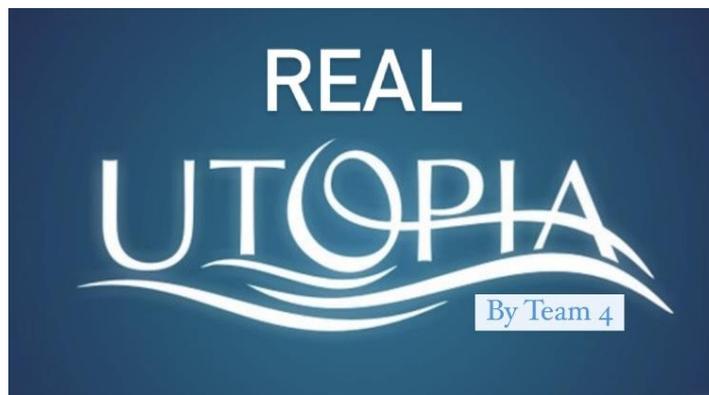


## CONCEPT PAPER

**Team Name (please do not include the name of the school or the city you come from):**

Team 4

Project name: **Real-Utopia**



**Team members:**

***SHORT DESCRIPTION OF YOUR SOLUTION (Maximum three sentences)***

Nowadays and in the future, e-commerce will have a great impact on our lives and on the planet we live in, besides the pandemic has been the catalyst of this process. Therefore our solution focuses on decarbonization of our e-commerce: bio-methane systems, heat pumps and relamping. Through those projects our intents are aimed to meet the National Integration Plan.

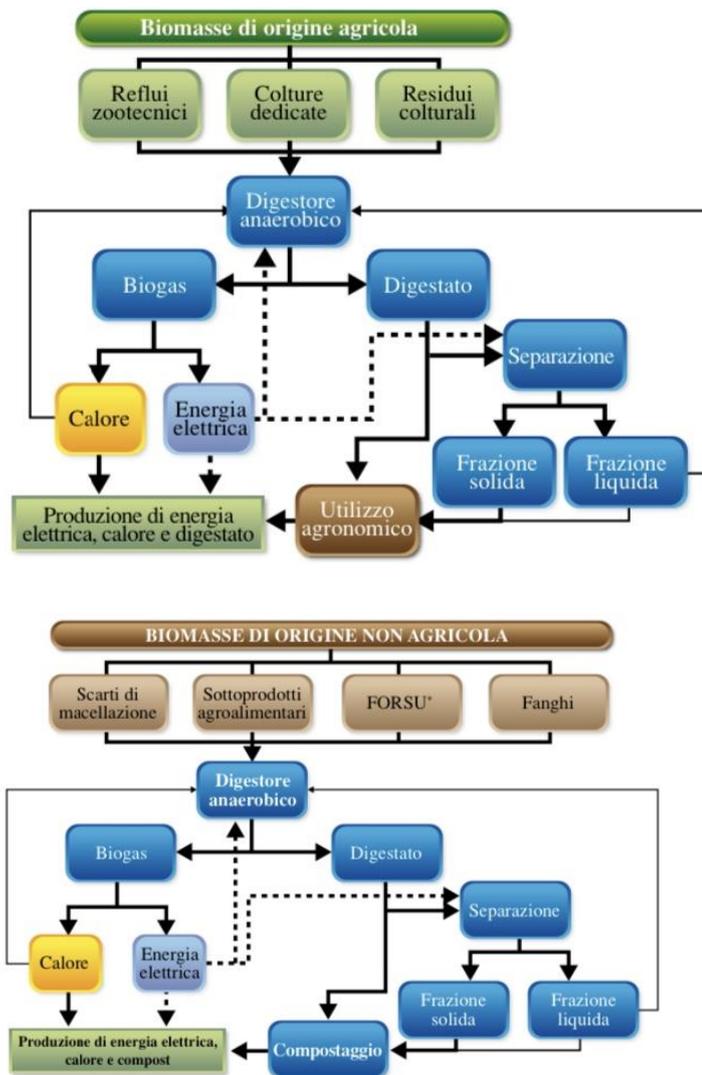
**EXECUTIVE SUMMARY**

**Executive summary** – very brief summary of the most important points of the Concept Paper: what will your plan deliver, why is your solution the best at meeting the selection criteria? (*Maximum 200 words*)

The first step in decarbonisation is the construction or transition to bio-methane-fueled plants.



Bio-methane is a renewable energy source that is obtained from agricultural BIOMASS, it comes from dedicated crops, by-products, animal wastes, industrial wastes, agro-industrial wastes from food chain processing and the organic fraction of solid waste.



In Europe, just over 1 billion cubic meters per year are currently produced; it is estimated that just in Italy 10 billion cubic meters of bio-methane can be produced by 2030, which amounts to about 15% of the national requirement.

It can be used not only as a fuel for transport but also for the production of electricity. In this regard, we offer relamping which, powered by bio-methane, consists in replacing obsolete halogen or incandescent bulbs with LED bulbs, known for their energy efficiency and sustainability. Through this (apparent) small change, we will be able to prevent the release of large quantities of CO<sub>2</sub> into the atmosphere.

By replacing approximately 1172 bulbs of different types (with LED bulbs), a CO<sub>2</sub> reduction of 24965kg is obtained, which is equivalent to planting 3329 trees.

In conclusion, another innovation are photovoltaic heat pumps, which use the CO<sub>2</sub> produced by the systems to heat the premises within e-commerce, thus reducing energy consumption. In this way, 35% of CO<sub>2</sub> emissions caused by traditional air conditioning systems could be saved. This machine uses photovoltaic to accumulate energy during the day and use it also when there isn't the light.

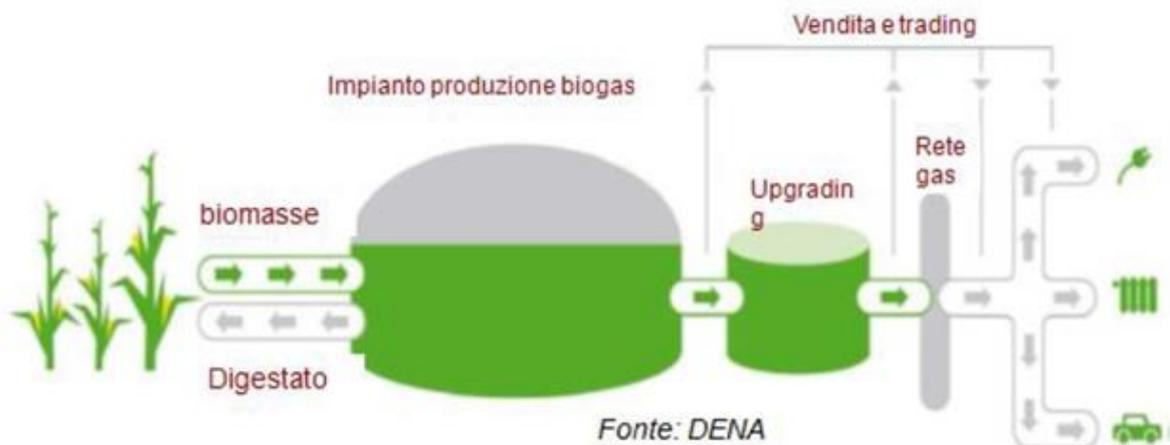
**SOLUTION**

**Detailed description of your solution** (design/function, features/benefits, creativity/innovation) (*Maximum 300 words*)

The obtainment of bio-methane takes place in two phases: production of biogas mainly through the anaerobic digestion of biomass and subsequent removal by means of a purification plant (UPGRADING) of the incompatible components up to obtaining 97% methane upon entry. The detailed operation of a biogas cogeneration plant naturally varies according to its type. The types of plants are numerous and depend primarily on the type of biomass used.

In general, biogas plants use anaerobic digestion for the production of biogas starting from biomass: thanks to specialized enzymes and bacteria, in a humid and oxygen-free environment (the DIGESTOR), the biomass ferments producing biogas, consisting mainly of methane and carbon dioxide. We speak of DRY digestion when the biomass has a minimum solid content of 30%. WET digestion is defined instead if the biomass has a solid content of 10-15%.

The project consists in the purchase of a large advanced biomethane plant, powered by FORSU (frazione organica del rifiuto solido umano) and the construction of advanced bio-methane plants and also microalgae plants for the production vegetable oil used as an additive to hydrocarbons and sold to oil companies. (from the Ministerial decree of 2018 are obliged to purchase this product).





Furthermore the installation of photovoltaic heat pumps could reduce to zero the emission of CO<sub>2</sub>. This is a reverse cycle machine that works with electricity and allows us to save 60% of fuels.

Put this machine instead of the boiler give hot water in winter and cold water in summer without excessive spending.

Q

About relamping: Advantages from LED bulbs

- less heat dispersion and consequent lower CO<sub>2</sub> consumption (because you use less energy), therefore **less environmental impact they**
- can be **powered by renewable energy**
- **less energy costs** (in the bill) and **less maintenance costs**
- **longer life** of halogen or incandescent bulbs
- **greater brightness, safety and visual comfort**
- **you are incentivized** by the state with deductions (white certificates, tax credit and super amortization)
- low times for **return on investment (ROI)**



**Impact of your solution** -- use your Science-Technology-Engineering-Math skills to estimate or calculate the impact of your solution. Explain why your solution is the best way of making e-Commerce as efficient as possible. (*Maximum 300 words*)

By using bio-methane it is possible to considerably reduce the emission of greenhouse gases CO<sub>2</sub> (-80%), fine particulate matter (-95%), NO<sub>x</sub> (-74%).

For these reasons, bio-methane represents the Italian way of decarbonising transport. A car powered by bio-methane produces greenhouse gas emission comparable to those of an electric car powered by a wind farm, as well as having very low particulate emission. The CO<sub>2</sub> emissions (values expressed in g CO<sub>2</sub> eq/km) are 164 for a petrol engine, 156 for a diesel engine, 141 for one with LPG, 124 for one with natural gas, against 5 for a bio-methane engine. It is the same number as a 100% wind electric vehicle. So the benefits are so much!

Relamping has one of the most impactful data on emissions.

A LED bulb consumes between 3-11Wh average. An incandescent bulb consumes 110-120W average. Considering arbitrarily 1500 bulbs that need to be replaced in one industry and considering that the number of SME in Italy amounts to 5,3 millions:

1500 bulbs x 11Wh = 16'500 Wh = 16,5 kWh

5,3 millions SME x 16,5 kWh = 87'450'000 kWh

1500 bulbs x 120Wh = 180'000 Wh = 180 kWh

5,3 million SME x 180 kWh = 954'000'000 kWh

In Italy the most used source for electric energy is natural gas, which has a carbon intensity of 500 gCO<sub>2</sub>/kWh, therefore:

LED impact on atmosphere amounts to: 87'450'000 kWh x 500 gCO<sub>2</sub>/kWh = 4,3725 x 10<sup>7</sup> kgCO<sub>2</sub>

Incandescent bulbs impact on atmosphere amounts to: 954'000'000 kWh x 500 gCO<sub>2</sub>/kWh = 4,77 x 10<sup>7</sup> kgCO<sub>2</sub>

Impact of photovoltaic systems: a panel will take two years of operation to repay the carbon footprint generated to produce it.

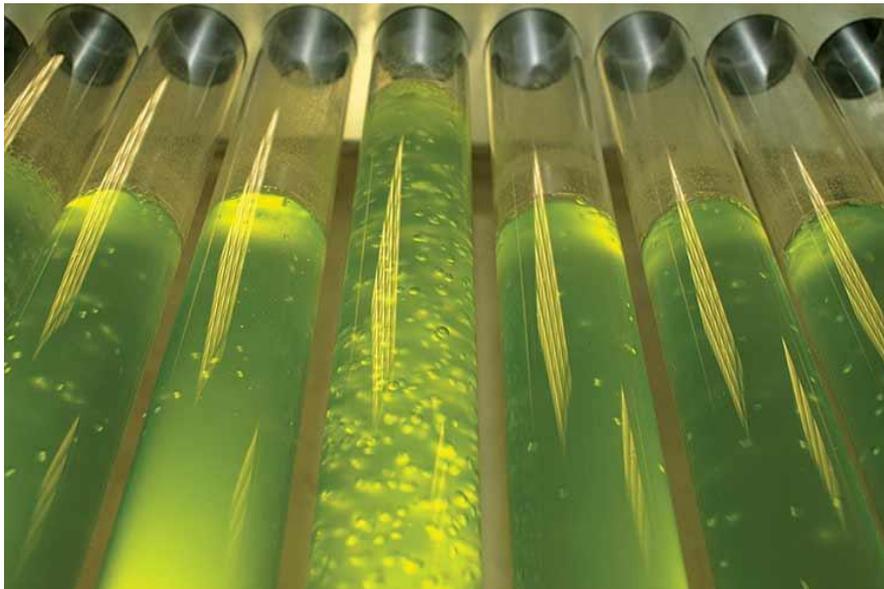
Some studies also showed that the increase in solar energy production capacity reduces the energy required to produce a panel and also the related CO<sub>2</sub> emissions (by 12% and 17-24%). About its disposal: Italian legislation provides for a procedure to avoid the dispersion of polluting materials into the environment and to optimize the recovery of recyclable materials. In this way it is possible to separate aluminum, plastic, glass, copper, silver and silicon, or cadmium telluride, depending on the type of panel. These substances will be recycled in the photovoltaic market for the production of new panels: the percentage of recovered material can reach up to 95%.

### **FEASIBILITY**

**Uniqueness** – compared to other solutions: what is special about yours? Why should the jury select your solution? (*Maximum 300 words*)

The reason why our project is at the forefront is because it is based on the concept of dual challenge. It is a project that is still feasible today because there are already about 30 active plants in Italy and over 400 in Germany.

Close to 4 bio methane plants, 4 microalgae plants of 3ha each will be built for the production of biofuels. There is a notable synergy between the bio methane plants and those for the production of microalgae; in fact the CO<sub>2</sub> extracted from the Biogas plant, from the purification plant(Upgrading), first described to reach a concentration of 97% of methane, represents, with light, the primary to produce through the appropriate bi-reactors, of microalgae.



The production process of these microalgae develops in two phases: the first one lasting one day is called autotrophic and consists in the use of microorganisms inside tubes filled with water, 4.5 meters high, called photobioreactors. The photosynthesis process is used and requires two "ingredients: light and co<sub>2</sub> (an algae plant of one hectare of surface filters the amount of co<sub>2</sub> equivalent to a 150 hectare forest). The second phase, lasting four days, it is called heterotrophic and consists in moving the alga from the photobioreactor to the fermenter and then feeding it with organic residues that are difficult to dismantle such as, for example, the powder or liquid digester coming from the biomethanization stations.

There are a lot of advantages for this solution:

- low or zero cost of the matrix;
- availability in neighboring territorial areas in the numerous Italian livestock districts;
- valorisation of waste and potential income integration of the livestock farm;
- presence of pre-existing storage facilities
- creation of easier outlet possibilities for the digestate, when spreading in non-farm soils is provided;
- stabilization with reduction of malodorous emissions;

- possibility of using different matrices (even residual ones) in the mixture in the digestion processes.

**Technology** - What technology or scientific knowledge does your solution require? (*Maximum 300 words*)

The technology or scientific knowledge that our solution require are:

**-About bio-methane:**

phases of the anaerobic digestion and biogas production process;

- type and characteristics of usable biomasses;
- main plant types of potential interest for region where we want to give a development to this project;
- picture of the current diffusion of technology and prospects for evolution. The aim is to provide the reader with the basic elements of the subject and the ideas to develop the appropriate insights on this particular form of energy production;

Also know how to operate and care for such a plant.

**-About photovoltaic systems:**

knowledge about thermodynamics

**-About relamping:**

electricity, energy and economic aspect

**Economy** - use your Science-Technology-Engineering-Math and Economic skills to estimate or calculate the cost of your solution. Explain why your solution is inclusive and affordable. (*Maximum 300 words*)

The article 7 of the Decree dated 02/03/2018 encourages producers of advanced biomethane for the release of the biomethane produced by recognizing the value of the CICs and any increases by attributing a value of 375 Euros to each certificate. The plants must come into operation by 12/31/2022.

1 CIC is equivalent to 615 m<sup>3</sup> of methane, therefore the valuation price of the CIC, defined on the basis of the date of entry into operation, remains unchanged for the entire incentive period.

There is also a surcharge for each liquefaction plant built up to an amount of €1,200,00 for each plant, as shown in the BP of each individual intervention.

The total cost on relamping of 1172 elements including installation and aerial platform is € 45,000 (rounded down). Overall, the savings on the electricity bill is € 31,000

Incentives are also applicable (tax credits and White certificates) that allow the deduction of 40%.

Electricity cost in Italy amounts to EUR 0,1503 per kWh (Eurostat 2020)

The total cost of LED bulbs on electricity in SME amounts to:

$$87'500'000 \text{ kWh} \times 0.1503 \text{ €/kWh} = \text{€}13'151'250$$

The total cost for incandescent bulbs on electricity in SME is:

$$954'000'000 \text{ kWh} \times 0.1503 \text{ €/kWh} = \text{€}143'386'200$$

The installation of heat pumps can take advantage of the non-repayable incentives of the Thermal Account, which cover 40% of the investment or a deduction of 65% can be applied. The cost of a heat pump can vary from € 6,000 to € 10,000, but applying the bonuses the cost would be reduced to around € 2,000. This expense will be repaid in less than 3 years thanks to the savings in the bill.

#### TOTAL COSTS:

- 1) Bio-methane plant: €15,895,000 - €2,000,000 = €13,895,000 + unexpected events
- 2) Relamping (1,000 light bulbs) : €38,395 - €15,358= €23,037
- 3) Heat pumps plant: €10,000 - €2,000 = €8,000

TOTAL: €13,926,037 + unexpected events