POLITECNICO DI TORINO

Master of science program in Energy and Nuclear Engineering

Course of Polygeneration and Advanced Energy Plants – 01QGXND

Feasibility study (techno-economic evaluation) of a biogas-fed SOFC system

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Contents

List of Tables

List of Figures

Introduction and plant description:

The goal of the laboratory activity is to perform a techno-economic analysis of a biogas-fed SOFC plant. The plant under investigation it is composed by an anaerobic digestor system and a cogeneration unit.
Inside the anaerobic digestors, the biomass feedstock, which can come from of agricultural waste, municipal waste, plant material or food waste, it is converted into biogas though an anaerobic digestion. This process is composed by several steps, in which microorganisms break down the biodegradable fraction of matter in an environment characterized by the absence of oxygen. At the end, the system is able to produce a biogas, which is a gaseous mixture of methane, carbon dioxide and impurities. Then, the biogas produced is sent to the cogeneration unit, in which are present several fuel cell. In this way, thanks to the usage of the fuel cells it is possible to produce electric power and thermal power which can be sold in the market. The fuel cells selected for the analysis are the solid oxide fuel cells (**SOFC**). These cells are characterized by a very high working temperature which can varies between 500°C and 1000 °C. As a consequence of that, all the thermodynamic and kinetic processes are enhanced allowing to reach efficiency levels around 60%.
In this first section of the project is performed the site selection analysis to find an optimal location for the plant. It has been decided to consider a Waste Water Treatment Plant (WWTP) present in the city of Florence. The choice has been done since Firenze is highly inhabited, so the available biomass feedstock can satisfy the needs of the plants. The data related to the population of the area [1] and biogas produced are collected in table 1.

Table 1 - Input data and biogas values

Population of Florence	367874	habitants
WW production	220	l/day/capita
sludge feed	0.5	m3/year/capita
biogas	2.62	Nm3/year/capita
Density biogas	1.2	kg/m3
Fuel Utilization	70	%
TOT WW prod	80932280	l/day
TOT sludge feed	183’937	m3/year
TOT biogas [year]	963829.88	Nm3/year
TOT biogas [hour]	110.03	Nm3/hour

SOFC System description

The solid oxide fuel cell is a fuel cell device capable of producing electrical power and heat even starting from a carbon-based fuel. The problem of these kind of fuels is that, at high temperatures these could decompose and create harmful carbon deposits, so the fuel has to react with an oxygen carrier molecule in a reformer to then avoid the formation of carbon depositions over the electrolyte, which would completely damage it.
The whole SOFC system has been modelized by using the Aspen software, and that’s the representation obtained:

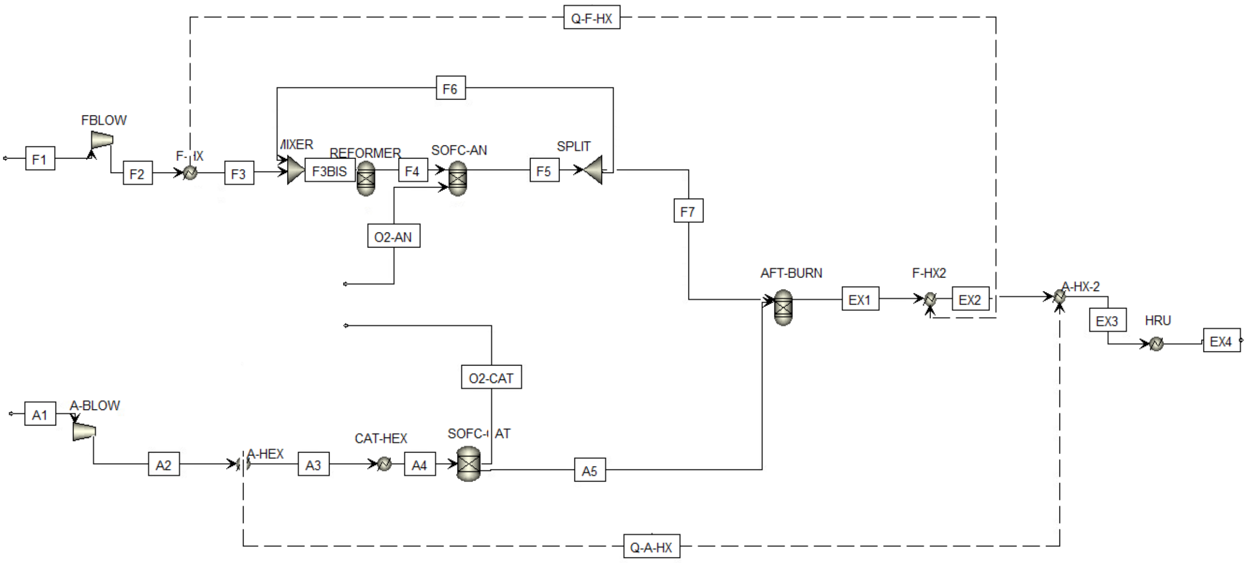

Figure 1- ASPEN scheme of the solid oxide fuel cell

In the reformer, which is an indirect internal reformer, the heat requested by the reaction is provided by the SOFC itself. The reaction is the steam reforming, reported here:

$$CH_4 + H_2O + heat \rightarrow CO + 3H_2$$

The amount of water needed to carry out properly the reaction, avoiding the thermal cracking of the methane (and so the carbon production), considers having more water than the stoichiometric need. Considering the molar flows of H_2O and CH_4 , the steam to carbon ratio wanted is the following:

$$SC = \frac{\dot{n}_{H_2O}}{\dot{n}_{CH_4}} = 2.5$$

The water needed is recirculated from the anode outlet.
In the anode the chemical reaction, which delivers the electrons is:

$$H_2 + O^{2-} \rightarrow 2e^- + H_2O$$

In the cathode the reaction, which delivers the ions is:

$$\frac{1}{2}O_2 + 2e^- \rightarrow O^{2-}$$

Then, in the system are needed other components, and are:

- Blowers: one for the fuel and another for the air
- Heat exchangers: even in this case, one for the fuel which then enters the reformer and another for the air, which then enters the cell being furthermore heated (this is modeled in Aspen through another heat exchanger)
- After burner reactor: needed to burn the unreacted fuel, hydrogen and carbon monoxide
- A heat exchanger which models a possible user of the excess heat produced, which in this case is supposed to be a district heating network and the biogas plant which needs a certain amount of heat (supposed to be 60 % of the available value) to work

The flowrate of oxygen (and so then the air request) sent to the cathode and the amount of recirculated output stream of the anode are found by the software itself. The first one by considering that the heat provided to the air in the fuel cell has to be the same lost by the cell after this colder air injection, while the second by considering that the stream to carbon ratio must be, as already said, 2.5.
It's possible to visualize down here the results of the simulation:

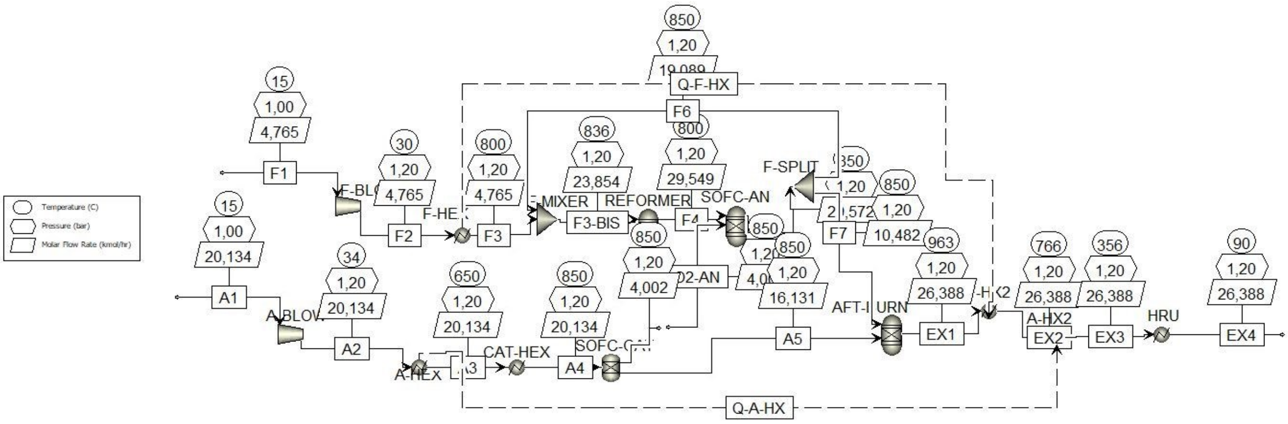

Figure 2 - ASPEN scheme of the solid oxide fuel cell showing the simulation results.

The solid oxides fuel cell could produce 343 kW of DC electric power. The electricity produced by the fuel cell is in continuous current, but to be injected in the grid (or used for the auxiliary components) it must be in alternate current. Therefore, the net electricity power produced by the system, after taking into account the efficiency of the inverter (in this case was supposed to be 95%), is about 326 kWe.

This amount must be lowered by considering all the auxiliaries of the system. These components, which are essential for the operation of the system, are the two blowers used to feed the system with the required amount of air and fuel (in this case biogas). The first one, which pushes the air inside, needs a power of 4698 W, while the second one needs just 1103 W of electricity. This relevant difference of power is because, in the first one the molar flow rate is about 20,13 kmol/h while in the second case the amount is extremely lower (4,76 kmol/h). The ratio of the molar flow rates is equal to the one of the powers.

After these results, it is possible to choose the size (capacity) and the number of modules of the SOFC. The aim is to satisfy the need of 320 kW of net power producible. This value is the maximum net power that a solid oxides fuel cell could produce by using all the biogas that the wastewater can deliver. It has been chosen a module of 58 kW of rated net power, produced by Convion, which is one of the leading companies in the development of commercial solid oxide fuel cells [2] thus the number of modules needed was $\frac{320}{58} = 5.52$, so it has been decided to oversize the fuel cell by choosing 6 modules. This oversize is also made to account for future increase in biogas production or in the population of Florence.

The cell produces also thermal power as product. A fraction will be used to pre heat the reagents before entering the SOFC itself, which works at temperatures higher than 800°C; the remaining part is the useful heat which is supposed to be injected in the district heating network of Florence. The total amount of heat, which is available at 963 °C, is the sum of four fractions (Figure 3). A part is sold to the district heating network (about 25.2 kW) and another is used to heat the matter in the anaerobic digester (38 kW). Another part is used to pre heat the air (about 106 kW) and the last one is consumed by the preheater of the fuel (about 54,4 kW).

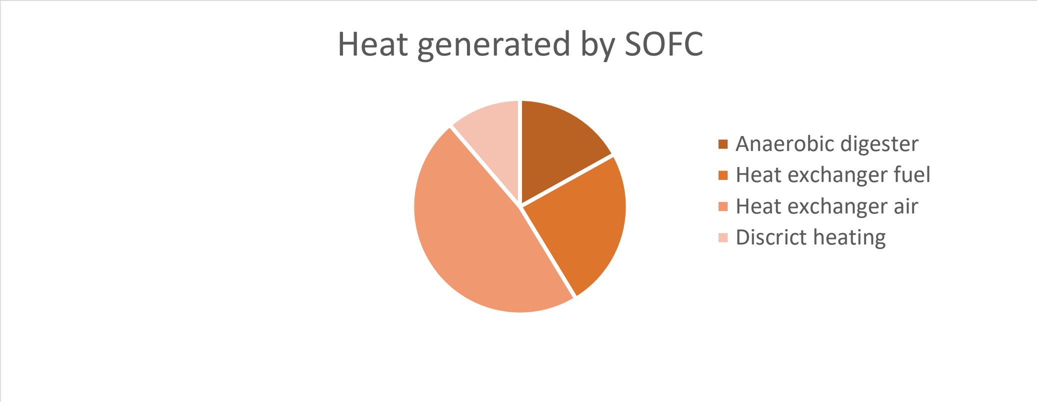

Figure 3 - Heat generated by SOFC

Finally, two efficiencies can be evaluated: the electricity one and the thermal one. For the first one, it can be calculated for the DC and the AC.

$$\eta_{el\_DC} = \frac{W_{el\_DC}}{\dot{v}_{fuel} \cdot LHV_{fuel}} \qquad \eta_{el\_AC} = \frac{W_{el\_AC}}{\dot{v}_{fuel} \cdot LHV_{fuel}}$$

- $\dot{v}_{fuel}$ is defined as the fuel volumetric flowrate, and its value is 0.031 $\left[\frac{m^3}{s}\right]$
- LHV_{fuel} is defined as the lower heating value of the fuel, and its value is 22 $\left[\frac{MJ}{m^3}\right]$
- W_{el_DC} is the electricity produced by the SOFC
- W_{el_AC} is the electricity converted by the inverter

The results are 51.05% and 47.64%, the values are related by the efficiency of the inverter.
For what concerns the thermal efficiencies, also in this case two values can be calculated. The first one is the efficiency of the cell, the second one takes into account the preheaters too.
The calculations are:

$$\eta_{th\_SOFC} = \frac{Q_{DH+digester} + Q_{HX\_fuel} + Q_{HX\_air}}{\dot{v}_{fuel} \cdot LHV_{fuel}} \qquad \eta_{th\_tot} = \frac{Q_{DH+digester}}{\dot{v}_{fuel} \cdot LHV_{fuel}}$$

- $Q_{DH+digester}$ is the heat provided to the district heating network and to the digester
- Q_{HX_fuel} is the heat provided to the fuel preheater
- Q_{HX_air} is the air provided to the fuel preheater

The results are 33.21% and 9.37%.
All the values of power and heat were given by the calculation made by the Aspen software, where all the system was modelized. The lower heating value is a common value for biogas produced from the wastewater treatment system while the volumetric flowrate of the fuel is a result of the calculation made considering the total population of the city of Florence.

Management of the Electric and Thermal Power:

After the evaluation of the electric and thermal power produced, it is needed the development of a market strategy to manage in a profitable way the plant. The main task is to understand how to split the different energy streams, as on one hand there are the power plant needs, while in the other there are the power fluxes that must be sold. The selection of the fraction that has to be sold is mainly linked to the value of the incentives provided by the government. Accounting the incentives contribution, the selling price of the electricity on the market is equal 0,253 €/kWh [3], while the one related to thermal power is 0,191 €/kWh [4]. For this reason, it has been selected to inject the total amount of the electricity produced into the grid, while the electric power needed to drive the plant is bought. On the contrary, regarding the heat it has been chosen to cover only the 60% of the internal requirements, while the remaining 40% is sold.

Analysis of the CAPEX and OPEX of the SOFC System:

The plant investment is called CAPEX, it is the investment cost that the plant owner pays at first. It includes different cost, such us the SOFC cost, the cleaning system cost, the thermal recovery cost and the plant preparation cost.
The cost of SOFC cell today (2022) is around 10-15 k€/kW in Europe, so it has been decided to take an average value of 12.5 k€/kW. By multiply this value for the rated power (348kW) of the fuel cells it is obtained a total equal to 4350000 €.
For the cost of the cleaning system, it has been considered the one which refers to short term equal to 1000 €/kWe. [5] In this way it is found a price of the cleaning system equal to 320295.11 €.
The thermal recovery cost is calculated with this formula:

$$C_1 = C_0 \cdot \left(\frac{S_1}{S_0}\right)^n$$

Where C0 is the heat recovery system investment cost equal to 50000 €, known for a certain size S0 that is 90 kWth and n is a scaling factor equal to 0.7, while S1 is equal to 63.024 kWth. The cost C1 is 38963.37 €.
Finally, the cost of plant preparation, integration and construction is assumed 150000 € as the plant rated power is 348 kW, so it is in the range 100-500 kW.
The total CAPEX is the sum of the terms calculated above, so it is 4859258.48 €.
The OPEX are the operating costs that the plant owner has to pays or earns every year.
For the SOFC maintenance we consider the substitution of the reformer catalyst and the stack replacement.
The substitution of the reformer catalyst is assumed 1 time every year, and the formula is this one:

$$C_1 = C_0 \cdot \left(\frac{S_1}{S_0}\right)^n$$

Where C0 is equal to 500 €, the cost of the reformer catalyst substitution, known for a certain size S0 equal to 60 m3/h di biogas and n is a scaling factor 1. The size of plant under investigation (S1) is 110.03 m3/h, so C1 is 916.89 €.
The substitution of the clean-up adsorbent is 1 c€/kWhe so the cost is really small 3.20 €/y.
Concerning the substitution of the SOFC stack, two different scenarios are considered. One in which the replacement is done every 4 years during the 20 years of lifetime of the plant and another one in which the stack is replaced every 7 years.
The replacement cost is assumed as an average equal to the 30% of the SOFC investment cost that is 4350000 €. So finally, it is estimated equal to 1305000 €.

For the labor cost it is assumed to have 1 operator working part time for 20 hours/week, so it will cost 31200 €/y, as the cost of the operator is 30 €/h.
Finally, it has been considered the general maintenance equal to the 4 % of the total CAPEX every year, this is equal to 194370.34 €.

Cashflow Analysis:

The cash flow analysis is the study of the inflows and outflows of money of a business. There is an inflow of money when it is sold the electricity and the heat produced by the plant, while there is an outflow of money during operations associated to the OPEX.

In this case, for the computation of the cash flow, the capacity factor has been estimated as 63.5% [6], while the lifetime of the plant is expected to be 20 years.

Regarding the outflows of the plant, for the first year the overall yearly cost is calculated as the CAPEX, estimated as:

$$Costs_0 = CAPEX_{SOFC} + CAPEX_{clean\,up} + CAPEX_{HRU} + CAPEX_{others}$$

The values are summarized in the table below:

Table 2 - Summary of total expenditure

SOFC	4350000.00	€
CLEAN UP	320295.11	€
THERMAL RECOVERY	38963.37	€
OTHER	150000	€

From the second year the costs mainly depend on the stack replacement cost, OPEX and labor cost:

$$Costs_n = C_{SOFC,rep} + C_{OPEX,clean\,up} + CF(C_{OPEX,ref} + C_{OPEX,general} + C_{labour})$$

On the other hand, the incomes can be computed as:

$$Incomes_n = Incomes_{EL} + Incomes_{TH} + Savings_{EL} + Savings_{TH} =$$

$$= W_{EL,exp} \cdot h \cdot c_{subsidy} + W_{TH,exp} \cdot h \cdot c_{DH} + {W_{TH,self}}/{\eta_{GB}} \cdot h \cdot c_{gas}$$

This expression considers both the income derived from selling the products and the ones derived from incentives and subsidies [7]. The boiler efficiency η_{GB} is 85% [8].

The numerical values are summarized in the table below:

Table 3 - Summarizing of the unit costs, costs and number of hours related to the formula of incomes.

h operation	5562.6	h
Wel_exp	320.29511	kWe
Wth_exp	25.209772	kW
Wth_self	37.814657	kW
η_GB	0.85	
c_EL	0.253	€/kWh
c_DH	0.191	€/kWh
c_GAS	0.086	€/kWh

Another important parameter to take into account is the depreciation rate, that can be computed as:

$$Dep.Rate = \frac{Total\ Investment\ Cost}{Depriciation\ Time}$$

In this case the depreciation time is assumed as 10 years and the result is a depreciation rate equal to 485925.85 €/year.
It is also meaningful to take into account the taxes in the cash flow, in the years in which the cash flow is positive, taxes need to be paid. Since the power plant is assumed to be owned by independent power producers, the tax rate is assumed equal to 24 %.[9]

At this point the only thing that is missing is the calculation of the discounting factor:

$$Discounting\ Factor = (1 + WACC)^{-(n-n0)}$$

The WACC (Weighted Average Cost of Capital) depends on various factors such as the financial structure of the company and the risk of the project. For an investor-owned utility and a low risk project, its value is 3.40 %.
Finally, it is possible to analyze the cash flows for the entire lifetime of the plant, to this aim, two different cases have been studied. In the first case the stack replacement is every 7 years while in the second one the replacement is every 5 years.
The results are summarized in the reported in figura 4:

- Stack replacement every 7 years

YEARS	CAPEX	stack REPLACEMENT	Annual Cost	Total Cost	Incomes	Present Cash Flow (before taxes)	Depriciation Rate	Incomes and Costs	Taxes	Present Cash Flow (after taxes)	Discounting Factor	Discounted Cashflow	Cumulated Cashflow
1	-4859258			-4859258,5		-4859258,5	485925,8	-4859258	0,0	-4859258,5	1,00	-4859258,5	-4859258,5
2			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,97	565307,4	-4293951,0
3			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,94	546719,0	-3747232,1
4			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,90	528741,8	-3218490,3
5			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,87	511355,7	-2707134,6
6			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,85	494541,3	-2212593,3
7			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,82	478279,8	-1734313,6
8		-1305000	-143822,6	-1448822,6	734197,9	-714624,7	485925,8	-714624,7	0,0	-714624,7	0,79	-584729,2	-2319042,8
9			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,77	447343,3	-1871699,5
10			-143822,6	-143822,6	734197,9	590375,3	485925,8	590375,3	25067,9	565307,4	0,74	432633,7	-1439065,8
11			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,72	418407,9	-1020657,9
12			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,69	404649,8	-616008,1
13			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,67	391344,1	-224664,0
14			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,65	378475,9	153811,9
15		-1305000	-143822,6	-1448822,6	734197,9	-714624,7		-714624,7	0,0	-714624,7	0,63	-462712,3	-308900,4
16			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,61	353995,0	45094,6
17			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,59	342355,0	387449,6
18			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,57	331097,6	718547,2
19			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,55	320210,5	1038757,7
20			-143822,6	-143822,6	734197,9	590375,3		590375,3	25067,9	565307,4	0,53	309681,3	1348439,0

Figure 4 - 7 years replacement cashflow analysis

A more intuitive view of the cash flow can be seen through the figure 5:

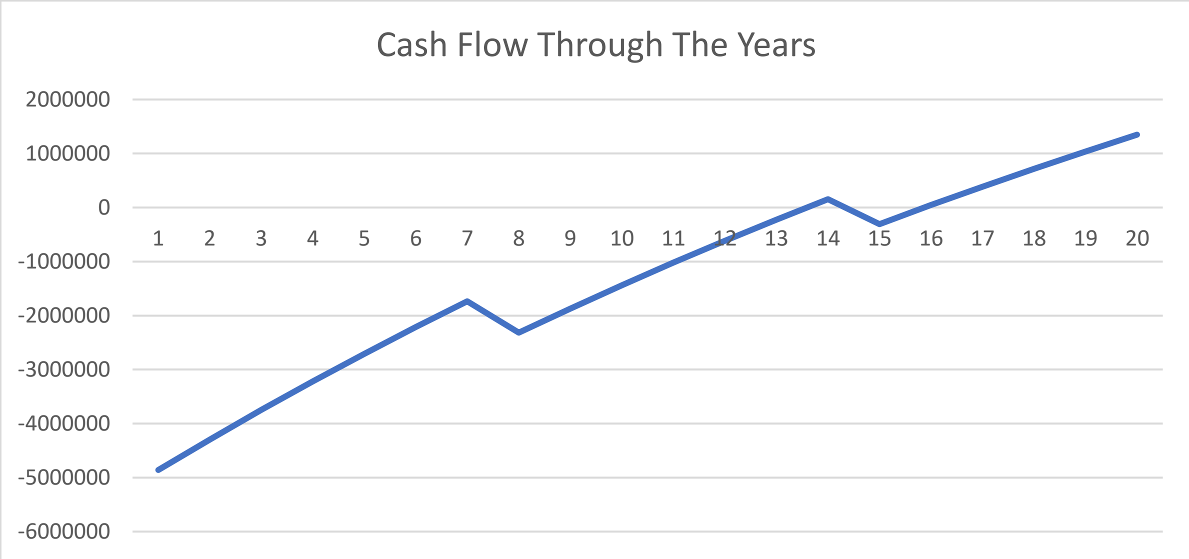

Figure 5 - 7 years replacement cashflow analysis through years

The stack replacement years are clearly marked with a descending trend, while it is possible to see that the payback time is around 14 years.
Some results are summarized below:

NPV	1348438,99	€
IRR	6,09	%

Since the Internal Rate of Return is higher than the WACC, it is possible to say that this investment is convenient from the economic perspective.

- Stack replacement every 5 years

YEARS	CAPEX	stack REPLACEMENT	Annual Cost	Total Cost	Incomes	Present Cash Flow (before taxes)	Depriciation Rate	Incomes and Costs	Taxes	Present Cash Flow (after taxes)	Discounting Factor	Discounted Cashflow	Cumulated Cashflow
1	-4859258,48			-4859258,48		-4859258,48	485925,848	-4859258,48	0	-4859258,48	1	-4859258,48	-4859258,48
2			-143822,591	-143822,591	737360,703	593538,112	485925,848	593538,112	25826,9434	567711,169	0,96711799	567711,169	-4291547,31
3			-143822,591	-143822,591	737360,703	593538,112	485925,848	593538,112	25826,9434	567711,169	0,9353172	549043,684	-3742503,63
4			-143822,591	-143822,591	737360,703	593538,112	485925,848	593538,112	25826,9434	567711,169	0,90456209	530990,023	-3211513,61
5		-1305000	-143822,591	-1448822,59	737360,703	-711461,888	485925,848	-711461,888	0	-711461,888	0,87481827	-643561,454	-3855075,06
6			-143822,591	-143822,591	737360,703	593538,112	485925,848	593538,112	25826,9434	567711,169	0,84605249	496644,103	-3358430,96
7			-143822,591	-143822,591	737360,703	593538,112	485925,848	593538,112	25826,9434	567711,169	0,81823258	480313,446	-2878117,51
8			-143822,591	-143822,591	737360,703	593538,112	485925,848	593538,112	25826,9434	567711,169	0,79132745	464519,774	-2413597,74
9		-1305000	-143822,591	-1448822,59	737360,703	-711461,888	485925,848	-711461,888	0	-711461,888	0,76530701	-562999,318	-2976597,05
10			-143822,591	-143822,591	737360,703	593538,112	485925,848	593538,112	25826,9434	567711,169	0,74014217	434473,336	-2542123,72
11			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,71580481	420186,979	-2121936,74
12			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,69226771	406370,385	-1715566,36
13		-1305000	-143822,591	-1448822,59	737360,703	-711461,888		-711461,888	0	-711461,888	0,66950455	-492522,09	-2208088,45
14			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,6474899	380085,213	-1828003,23
15			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,62619913	367587,246	-1460415,99
16			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,60560844	355500,238	-1104915,75
17		-1305000	-143822,591	-1448822,59	737360,703	-711461,888		-711461,888	0	-711461,888	0,58569482	-430867,323	-1535783,07
18			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,56643599	332505,488	-1203277,58
19			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,54781044	321572,039	-881705,544
20			-143822,591	-143822,591	737360,703	593538,112		593538,112	25826,9434	567711,169	0,52979733	310998,104	-570707,441

Figure 6 - 5 years replacement cashflow analysis

Also in this case it is possible to show a plot (figure 7):

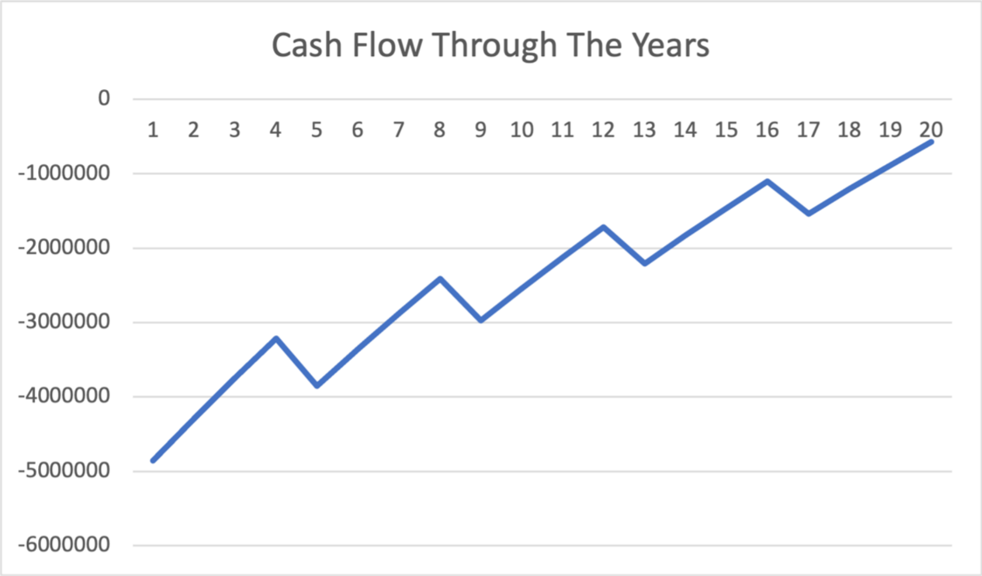

Figure 7 - 5 years replacement cashflow analysis through years

It is immediately possible to see that the investment does not reach the payback time in the 20 years of the lifetime of the plant, therefore this configuration is not sustainable from an economic point of view. This happens because we are replacing the stack with a higher frequency and therefore we are spending more money for this procedure.
Some other results are summarized below:

NPV	-570707,44	€
IRR	1,6	%

In this case the IRR is lower than the WACC, we can say that this investment is not convenient from the economic point of view, another confirmation of the fact that this second case is less profitable than the previous one.

Conclusions

Through the Wastewater Treatment Plant of Florence, the management of wastewater is combined with the production of electricity and thermal power. By the anaerobic digestion of biomass, it has been obtained 110.3 Nm3/hour of biogas to feed the SOFC stack, in order to produce 326 kW of electricity and 63 kW of thermal power.
From this output, all the electricity is injected to the grid; concerning the thermal power only the 40 % is sold to the user, since the 60 % is sent to the digestor.
From the economic analysis, 2 cases are developed to show a good economic scenario, in which the cells in the stack are replaced only 2 times and a worst one in which the substitutions are 4.
In the first case the investment results to be profitable, reaching a final NPV equal to 1348438,99 € and an internal rate of return of approximately 6,09 %. In the worst scenario instead, the investment is not economically affordable, due to the heavy contribution related to the cost of the replacement of the fuel cell. At the end of the lifetime the net present value results to be negative, with a value of -570707,44 €. The internal rate of return in the second case is 1,6 %. It is finally clear from this comparison that, for the implementation of this type of plant the stack can be replaced every seven years or more, to make the project economically feasible.

References

[1] ISTAT, "demo," 2022. [Online]. Available: https://demo.istat.it/..

[2] Convion, "Convion product focus," [Online]. Available: https://convion.fi/products/.

[3] Eurostat, "Electricity and gas prices in the first half of 2022," 2022. [Online]. Available: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20221031-1.

[4] Arera, "COSTI DEL SERVIZIO DI TELERISCALDAMENTO," 2022. [Online]. Available: https://www.arera.it/allegati/docs/22/547-22alla.pdf.

[5] U.S. Department of Energy, "Gas Clean-Up for Fuel Cell," 2014. [Online]. Available: https://www.energy.gov/sites/prod/files/2016/04/f30/fcto_gas_cleanup_workshop_report.pdf.

[6] B. Alves, "Capacity factors for selected energy sources," 2022. [Online]. Available: https://www.statista.com/statistics/183680/us-average-capacity-factors-by-selected-energy-source-since-1998/.

[7] GSE, "ACCESSO AGLI INCENTIVI," 2019. [Online]. Available: https://www.gse.it/servizi-per-te/fonti-rinnovabili/fer-elettriche.

[8] ScottishPower Energy Retail Limited, "How efficient is my boiler?," 2021. [Online]. Available: https://www.scottishpower.co.uk/blog/how-efficient-is-my-boiler#:~:text=The%20figure%20will%20range%20from,at%20least%2015%20years%20old.

[9] M. d. e. d. finanze, "Imposta sui redditi delle società - Ires," 2020. [Online]. Available: https://www.agenziaentrate.gov.it/portale/web/guest/imposta-sui-redditi-societa-ires/infogen-imposta-sui-redditi-societa-ires.