Environmental Engineering and Management Journal *October 2021, Vol. 20, No. 10, 1593-1598*
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

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COGENERATION MANAGEMENT SYSTEMS IN PUBLIC AND PRIVATE SECTOR: SECOND CIRCULAR FINANCE MODEL

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Abstract

The Italian context is currently characterized by an economic crisis and by the need to eco-innovate the production and management processes of the same. In this situation it is necessary to implement development strategies that do not increase the debt in the state budget and local authorities. To achieve this goal, as for the cogenerate energy processes with the same amount of resource, various forms of energy are produced (electricity, heat, steam) thus maximizing the results. For the financial and economic processes there is a strategy that leads to the same amount of resources used to maximize results. The public sector through the National Recovery and Resilience Plan (NRRP) and the Ministry of Economic Development (MISE) supports the eco-innovative and resilient development processes through incentives, tax reliefs, grants.
The NRRP speaks of resilience, in this context the biological concept of self-pity is introduced, a system that continually redefines itself and is sustained and reproduced from within by applying it to the economic and financial system of the country.
In this paper, the second model of circular finance is introduced and explained a model that starting from the integrated planning of economic variables of the public and private sectors identifies the system economies able in the medium and long term, through the economic benefits derived, to self-finance the industrial eco-innovative processes of a Country. In short, the process of industrial sustainability is self-financing through the benefits arising from the system.

Key words: circular finance, circular economy, cogeneration, eco-innovation, financial cogeneration, public-private management

Received: April, 2020; Revised final: August, 2021; Accepted: September, 2021; Published in final edited form: October, 2021

1. Introduction

Starting from public accounting, state budget and budgets of local authorities, identifying the budget items, variables, both intended as expenses related to the safeguarding and protection of the environment and expenses related to incentives, tax reliefs, grants (Milano et al., 2015). By identifying the variables relating to the private sector, production costs, environmental protection costs, costs linked to industrial eco-innovation for the transition from a linear to a circular economy.

Industry today must eco-innovate in order to be competitive (UN, 2015). According to the European Union's definition of eco-innovation: "The key to Europe's future competitiveness (UNEP, 2015).

Eco-innovation means any innovation that results in significant progress towards the goal of sustainable development by reducing the impacts of our production methods on the environment, strengthening nature's resilience to environmental pressures, or enabling a more efficient and responsible use of natural resources (UNEP, 2016).

Eco-innovation also represents an opportunity for companies because it leads to lower costs, helps to seize new growth opportunities and improves the company's image in the eyes of consumers (European Commission 2015). In addition, the search for new industrial eco-innovation processes leads to greater process knowledge, production of innovative materials, thus greater know-how in process management and chemical management, and greater system flexibility (European Commission, 2019).

In order to eco-innovate production processes,

variables to the public sector, budget expenditures, budget expenditures for environmental protection and protection (waste management, environmental damage management for examples) (Donida et al., 2015). By placing the economic determinants of the public and private sectors within the same system, it is possible to obtain intersectoral system economies capable of generating value autonomously.

In many cases, the implementation of an innovative eco-process by the private sector can result in decreased spending by the public sector. Systemic economies can thus be achieved in this context. The joint management of the economic and financial budgets of the public and private sectors leads to the identification and enjoyment of these economies and thus have benefits for society as a whole.

The intersectoral matrix of cogeneration management generates system economies that can give rise to a state of system self-financing or circular finance. This document proposes a strategy for managing intersectoral matrices called: "**Integrated public and private sector cogeneration system**". System consisting of three subsystems: private sector, public sector, environment, Fig.1.

2. Variables of a complex cogeneration system

In order to maximize the benefits of an integrated public-private system, and therefore to maximize system economies, it is necessary to identify the determining variables of the complex system. With this aim, the potential common targets of the two spheres public sector and private sector are identified. In order to maximize the benefits of an integrated public-private system, and therefore to maximize system economies, it is necessary to identify the determining variables of the complex system. With this aim, the potential common targets of the two spheres public sector and private sector are identified. Integrated management thus leads to greater efficiency and effectiveness of administrative action (as required by the Public Function).

Therefore, it leads to maximization in the achievement of targets with maximization of economic performances (lower costs, lower expenses, higher derived revenues, maximization of management performance) and natural ones (energy and matter) with consequent lower environmental impacts. Fig. 2 shows the structure of the two spheres.

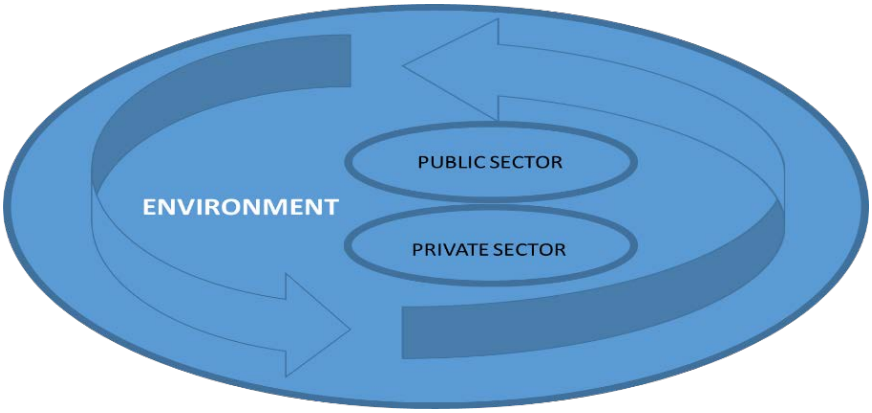

Fig. 1. Integrated cogeneration management

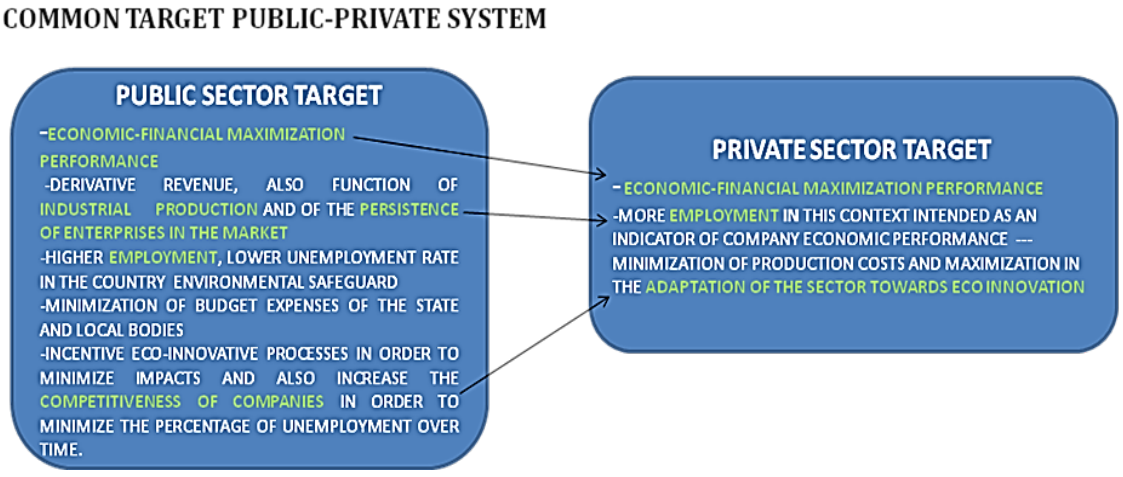

Fig. 2. Target public-private sector

By putting the two sectors, public and private, into a system, we can find the determining variables that must be evaluated in the choice of eco-innovative projects that should also be financed with public funds, therefore through contributions and tax relief. Thus, financing in a timely and determined manner only some private projects, those that also generate benefits in the public sphere, in the form of lower expenses in the budget of the State and public bodies and public administrations, thus continuing this assistance in the medium and long term. For example, the revamping with LED lamps instead of incandescent or halogen lamps used for public lighting generates energy savings in the long term and less maintenance of the equipment. Therefore, an initial investment to replace traditional lamps with LED ones is amortized on average in one year of operation, therefore the capital invested is reinstated in one year and subsequently we will have lower energy consumption and therefore savings in budgetary expenses for public administrations for the private sector a gain from the execution of the project and for the environment a saving on the impacts generated by the lower production of energy for lighting.

Cogeneration management between the public and private sectors consists of planning eco-innovative processes jointly, evaluating the economic and financial variables of the two sectors jointly. Through cogenerated management, thus defined, public-private system economies can be maximized to the point that an eco-innovative project can be financed by the future benefits (decrease in costs for the public sector, and decrease in expenses for the private sector) related to its implementation.

As energy cogeneration refers to the combined production of electricity and heat, public-private cogeneration management tends to increase the benefits of the system. From the implementation of an eco-innovative process, on the one hand the public sector can benefit by reducing future expenses related to environmental management and protection, and on the other hand the private sector can benefit economically (lower production costs, product differentiation, etc.).

Through the derived (derives from the compulsory withdrawal of wealth by the state from private individuals.) revenues, the State acquires the economic resources necessary to encourage eco-innovative processes in the public sector. By selecting only, the projects, to be incentivized-financed, that is, those that lead to public-private system benefits (which determine a reduction in public spending in the medium and long term) creates self-cogenerated, process that are self-fueling. For example, the budget of the Municipality of Rome in 2020 shows that expenditure on 'Sustainable development and protection of the territory and the environment' amounted to €1.360.290.569, or €479.43 per person (Rome Municipality, 2020).

From this evidence one can understand how important the government's investment process is and how public expenditure is used. From this evidence it is possible to understand how important the government's investment process is and how public expenditure is used, both for the public and private sectors, and for the citizen.

In particular, taking as a reference the expenses related to environmental protection, enhancement and recovery and the expenses related to waste we can imagine that if the Municipality financed even partially projects that lead to a reduction of these expenditure items, part or all of the invested capital would recover from future expenses not incurred. For example, if the Municipality of Rome financed only the eco-innovative projects that lead to a reduction in such expenses, these projects could have a good degree of self-financing from the private public system.

The Municipality of Rome by financing certain projects that comply with the rules that credit institutions follow for the self-sustainability of an investment. Specifically, credit institutions finance only projects that lead to an internal rate of return on invested capital, in the form of a loan, higher than the opportunity cost which is given by the rate of return that would be obtained by investing in the current average securities and real estate sector. In order to calculate this IRR, the Municipality should also include the sum of the expenses not incurred in the future budget. For example, if the Municipality granted a non-repayable grant to companies, for example equal to 10 M €, which treat waste and the recycling of such waste, resulting in lower future expenses in the Municipality's budget, due to the non-management of this part of the waste, there would be an indirect recovery of the investment. If the expenses not incurred were equal to 0.5 M € per year in 5 years, for example, there would be a self-financing rate of 25% and an IRR of 5%.

The public sector through the proceeds deriving from derived revenues (taxation from the private sector) grants incentives to companies, private sector. In the planning phase, eco-innovative projects of private companies should be encouraged, which tend to reduce public spending by the state and local public bodies in order to obtain system economies and therefore the tendency towards system self-financing. Fig. 3 shows the technique of the public-private cogeneration management system, the benefits of the public sector, reduction of expenses, compensate for the incentives given by the State to companies.

Therefore, planning and identification of eco-innovative projects according to this method leads in the medium and long term to make the investment process of the public and private sectors more efficient (Tanese et al., 2006). Thus, creating greater employment stability, greater penetration of companies in the market, increase in derived revenues, greater know-how of companies, thus bringing the national financial system to economic and financial autopoiesis, a system that continuously redefines itself and sustains and reproduces itself own internal.

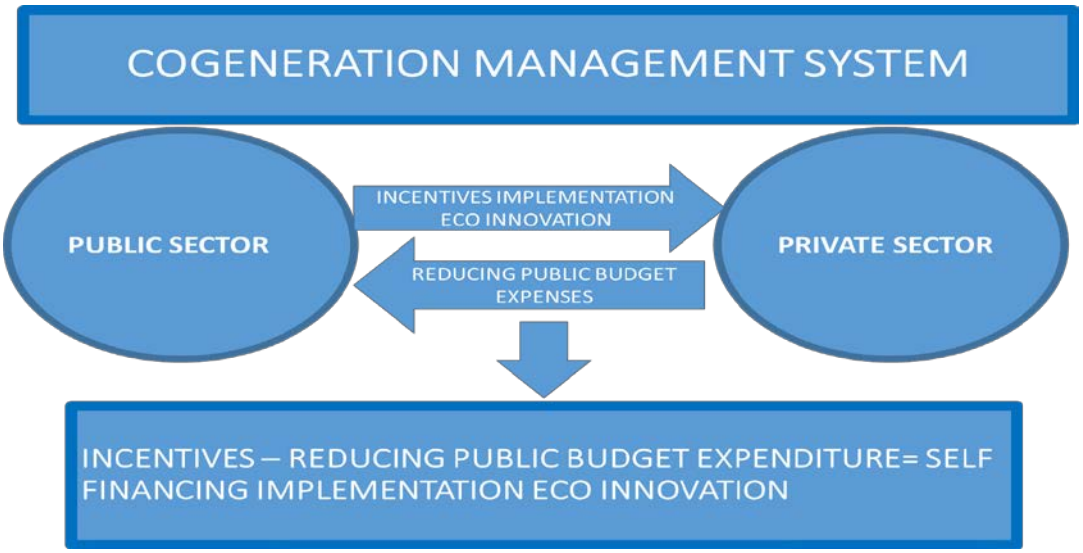

Fig. 3. Cogeneration management system

Initially we go to calculate the sum of all the benefits of public and private sector system resulting from the integrated management of the two spheres. Subsequently, by equalizing the initial investment to zero, we can obtain the interest rate that sets it at zero. In this case the investment is self-financed by future benefits, a state of total circular finance. When the interest rate thus obtained is equal to or greater than the opportunity cost (opportunity cost is the average interest rate that would be obtained by investing in the current securities and real estate market), banks consider the eco-innovative investment profitable and are willing to finance it.

Second circular finance model: mathematical model relating to the application of the concepts of circular finance (Eqs. 1-2):

$$NPV = \sum_{t=1}^{T} \frac{F\ public\ expenses\ reduction}{(1+i)^t} + \\ + \frac{F\ private\ sector\ benefits\ endogenous}{(1+i)^t} \quad (1)$$

$$I_0 = \sum_{t=1}^{T} \frac{F\ public\ expenses\ reduction}{(1+i)^t} + \\ + \frac{F\ private\ sector\ benefits\ endogenous}{(1+i)^t} \quad (2)$$

If $I_0=0;\ \ i \geq C_0$

Setting the initial investment I_0 equal to zero, we obtain the interest rate as a function of the time that leads to the total self-financing of the investment. If the discount rate that brings I_o equal to zero is equal to or greater than the opportunity cost (C_0) the investment is attractive for credit institutions. According to this logic, the State, by implementing this model to establish which investments to make or not, to which eco-innovative projects to contribute, could reduce the public debt and trigger a virtuous process that leads the private public system to economic and financial **autopoietism**.

Just as autopoiesis in biological systems, it can be seen as a network of constraints that work to maintain themselves, in the same way joint management between the public and private sectors leads to maximizing system economies and thus financially self-sustaining eco-innovative processes.

3. Circular finance techniques for the cogeneration system (public and private sector)

The concept of circular finance is based on the logic that an eco-innovative process can be financed by the future benefits of implementing the same. To achieve this goal, systemic benefits must be maximized. It is precisely through the joint management of the public and private sectors that economies of scale can be created that can increase the benefits.

The circular finance techniques for the cogeneration system (public and private sector) to follow to reach an autopoietic state of the system are:

1. plan circular finance strategy, implementing the second mathematical model of circular finance;
2. evaluation of private projects to be encouraged by the public sector on the basis of paradigms related to circular finance;
3. in a certain territory identification of system economies, contemporary public-private benefit;
4. in a certain territory identification of environmental criticalities o opportunity;
5. control: territorial strategic plans identified by the various actors present in the area.

The Italian Federative Association of Consulting Companies stated that "strategic planning allows to promote an intensification of the relationships existing between actors of the local

system who recognize and share the same development objectives". The Department of Public Function states: "The Local Authority must voluntarily decide to play an active role in the economic and social regeneration of the territory (Pisano et al., 2012; Sáez-Martínez et al., 2014) assuming the leadership role of the mobilization and coordination process of local actors, in the construction and implementation of a shared development vision." The TSP Territorial Strategic Plan already exists. In this context, with the collaboration of all the actors active in the area, the activities to be implemented are planned.

Almost all Italian municipalities have the TSP, it would be desirable if not necessary that the local public authorities evaluate the private projects to be financed with public contributions through the second circular economy model described in the previous chapter. In the following we will describe the projects that respond to the concept of system self-financing, circular finance.

The Macrolotto of Prato (Iraldo et al., 2011) was in a territorial situation in which the aquifer tended to resource depletion. In this context, the industrial district with the help of the Municipality has implemented a consortium for the purification of water thus avoiding the withdrawal of the aquifer, Fig. 4.

Fig. 4. Water purification Consortium CONSER Prato's district

Private individuals (Macrolotto di Prato) have had benefits as if the water table continued to be, resource depletion they would have been forced to supply water through tankers with consequent large costs.

The Municipality would have had enormous economic damage deriving from the depletion and loss of the water resource. So, public and private have decided to create this water purification consortium, the Municipality has disbursed € 300.000/year, a cost item passed on to the companies that continue to use groundwater. In this way, 5M/m^3 of groundwater per year was saved, equal to 125.000 (Tanese at al., 2006). There are many examples of eco-innovative projects that have led to system self-financing, where all the actors involved have benefited without burdening the state coffers and local public bodies. The technique lies in framing the criticality to be remedied or the opportunity that can generate the implementation of an eco-innovative process-system, through the business plan of the project it is possible to determine the future cash flows generated and the expenses avoided. By discounting the avoided flows and expenses, the interest rate generated is determined by placing the investment at zero time equal to zero. Once the interest rate has been determined, it is compared with the opportunity cost (rate deriving from an average investment or real estate at time zero).

The more a project determines a high internal rate of return, the greater the amount of self-financing of the system, the greater the attractiveness of credit institutions to lend capital, the greater the convenience also for the public sector to finance the project since in the medium and long term will generate value. With this technique an environmental problem of depletion of the aquifer has been solved without affecting the public sector coffers. Everyone benefited from it.

Many techniques of this type lead to system self-sustainability, circular finance. Other examples are the redevelopment of brownfields, soils polluted by disused industrial processes are redeveloped by private individuals or the public sector, thus generating value by reclaiming the territory and following the directives of the European Union regarding the objective of "consumption of new land equal zero before 2050".

4. Conclusions

In the context of the National Recovery and Resilience Plan (NRRP), this article proposes the second circular finance model. By incorporating public and private sector variables into the same system, financial resources are maximised by creating self-sustaining value, similar to autopoiesis in biology.

The system feeds itself from within, leading to greater independence from external financial sources. By assessing and selecting the projects that the public government should support, the system is economically and financially self-sustaining. The public sector can thus encourage eco-innovative projects without burdening the government coffers, thus generating value.

The public sector thus assumes a function of partial control of public and private investment. All actors benefit, the private sector by innovating, the public sector by increasing revenue derived, creating jobs and increasing employment stability, generating even more procedural know-how for both. The necessary tools are a territorial strategic plan that identifies projects that lead to self-financing, also reducing future public sector expenditure.

The Territorial Strategic Plan (STP) is already present in the territories and can be a valid tool to bring together all the actors in the territory and to implement the mathematical model of circular finance in this specific document that allows public administrations to identify the projects that create more value in the

public sector than in the private sector. In this way, by incentivising projects that produce greater system economies, a cogeneration system is created that from an initial vector generates value in several economic spheres, as in the energy sector from an energy vector with cogeneration there is the joint production of various products (electricity, steam, heat, other).

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