

CIRCULAR ECONOMY IN INDUSTRIAL DISTRICTS IN MINAS GERAIS, BRAZIL

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The circular economy got visibility after the creation of the Ellen MacArthur Foundation, in 2010. The term was said for the first time in 1966 by the economist Kenneth E. Boulding in his work entitled *The Economics of The Coming Spaceship Earth*, which pays respect to the integration of some areas to the maintenance of human life on Earth. Today, this concept aims to replace the current process of production-consumption-waste, known as linear economy, which has been calling the attention of some countries, companies and institutions. The European Union (EU), China and huge relevant corporations have already started the transition to the circular economy (CALIXTO; CISCATI, 2017).

The theme must be treated as priority, once that, in the last thirty years, demand of the consumers increased in 150%, whereas the technological development and increasing in the processes production raised the extraction of the feedstock economic value in only 40%, which was lower than the increase of the demand in the same period (CNI, 2018a). Therefore, alternatives for the current production, consumption and waste process must be worked and the circular economy is one way to face the problem of growing consumption and decreasing availability of feedstock.

In this concept, a lot of initiatives are possible in order to explore the pillars of the circular economy concept, involving new business models which prioritize the transition to the regenerative and restorative model in which the products, components and materials are kept in their highest levels of usage and value all the time (ELLEN MACARTHUR FOUNDATION, 2015). The Federação das Indústrias de Minas Gerais (FIEMG), through the Instituto Euvaldo Lodi – Núcleo Regional Minas Gerais (IEL/MG), in partnership with the Fundação de Amparo à Pesquisa de Minas Gerais (FAPEMIG), made a program to act in the industrial districts of the state to disseminate the concept of circular economy and propose collective business opportunities, which aim at the reuse and the implementation of resources from productive process in others, as well as the reduction of operational costs and the improvement of environmental indicators, the attraction of industries and investments to the region. In last instance, the goal of Programa de Economia Circular em Distritos Industriais is to contribute to the growth of cooperation between local industries and the competitiveness industries from Minas Gerais.

The concept of circular economy emerged in the 20th century, but only in the last decade of that period the idea started to be highlighted. In opposition to the current extract-use-waste, also known as linear economy, the circular economy is characterized as a restorative and regenerative model by principle, with the goal to keep products, components and materials in its highest level of utility and value for an infinite period of time. In this concept, the feedstock, products and residues produced are inserted in technical or biological cycles (ELLEN MACARTHUR FOUNDATION, 2015).

The technical cycles reinsert the products and their parts while the biological ones safely reinsert nutrients in the biosphere for decomposition, which consequently will be integrated in feedstock as value for a new cycle. This is one of the three principles that, together, work as guidelines to circular economy. The other two are, in their essence, focused on preserving and improving the natural capital through control of finite stocks and balance of the renewable resources flow and to a stimulus of the system effectiveness, revealing and excluding negative externalities since the beginning of the cycles (ELLEN MACARTHUR FOUNDATION, 2015).

This model presents huge economic advantage, once facing the commodities prices instability to the water shortage and the increasing cost of materials recovered and restored, as well as the reuse of feedstock derived from other chains. There was the implementation of the subject to the strategic map 2018–

2022 of the Confederação Nacional das Indústrias, in 2018, which affirms that the industry has an essential role in exploring opportunities within the subject (CNI, 2018a).

However, for the effective transition to circular economy, it is necessary to foment partnerships, once industry, society and environment are strongly related, and the cycles interpose one another, not being fruitful their isolation. Through these partnerships, an environment rich in opportunities of circular economy ideas application emerges.

In Brazil, a changing in the paradigm has been materializing itself through programs that, even not firstly recognized as circular economy actions, show convergence with the model values. It can be noted the initiatives in a bunch of industrial sectors. Some companies in the electronics sector have actions as reinsertion of equipment and printer supplies in the production of new equipment and solutions based in the reverse logistic, increasing the useful time of the components using the residue as resource. Besides that, the FIEMG's Programa Mineiro de Simbiose Industrial unites plenty of companies to reuse the resources, being an example on the usage of residues as resource (CNI, 2017).

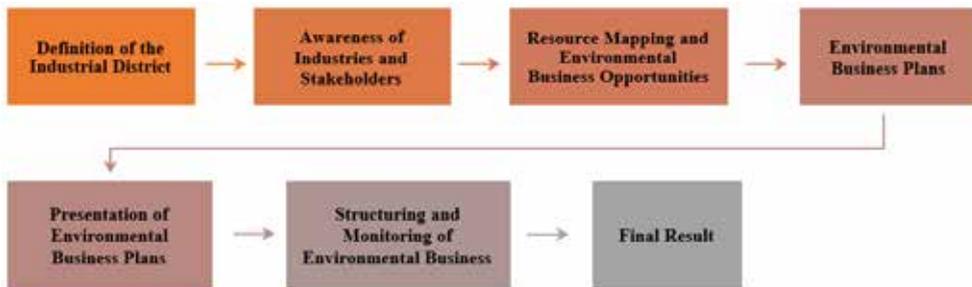
In 2017, it was also released the Programa de Economia Circular em Distritos Industriais, which is an initiative of FIEMG, with support of FAPEMIG, aiming to identify business opportunity in an industrial district increasing competitiveness of industries and promoting an environment of cooperation and sustainability (FIEMG, 2018). The initiative is an evolution of the Programa Mineiro de Simbiose Industrial, in which from 2009 to 2015 benefited more than 760 companies, that reduced almost R\$ 9 million in costs with acquisition of feedstock and materials. In the environmental aspect, it reused almost 140,000 tons of residues, besides the economy of 195,000 tons of feedstock and the reuse of almost 14,000 m³ of water (CNI, 2018b).

In the legal sector, the main point for the circular economy in Brazil is the law 12,305, also known as National Policy of Solid Residue, or NPSR, from 2010. Ruled in the principle of shared responsibility, it requests that all the generating and treatment lines of residues contribute to diminish the quantity generated and the impacts brought by the life cycle of the products. The law urged the end of dumps and attributed to city hall the responsibility of making easier to return reusable residues to the productive processes. Such guidelines are limited to solutions for the products last waste, neglecting the opportunities brought by the circular economy for the innovation and preservation of the value added of the feedstock, parts and products, as well as the actions of incentive to change soci-

ety’s paradigm about sustainable consumption. However, such policies are still recent and represent an opening for the companies to invest in circular solutions.

The methodology used for executing the Programa de Economia Circular em Distritos Industriais in the cities of Sete Lagoas and Uberaba consisted in three main stages (Figure 1): sensibilization of the interested parts, mapping of resources and opportunities and the elaboration and monitoring of collective business plan. The program was dimensioned to be executed in the period of one year. The stages of sensibilization, mapping of resources and opportunities and the business plan have scheduled duration of one, four and seven months, respectively.

Figure 1 – Stages scheme of the circular economy program



Source: Elaborated by the authors.

The stage awareness of industries and stakeholders has a goal to sensitize the associations and local universities, as well as the CEOs and decision makers of the mapped industries to participate in the program about the benefits of circular economy in the social, economic and environmental aspects. Once the partnerships between associations and local universities are made and the companies have already taken part of the project, the collaborators of participant companies are qualified in the theme of circular economy. In this way, companies are stimulated to apply the model concepts and identify the improvement opportunities inside their own productive process.

The first stage is finished with the official release of the program in the industrial district. The solemnity of releasing marks the beginning of the resource mapping activities, opportunities and actions, which already exist in the member industries. Such actions compose the second stage of the program, named resources mapping and opportunities identification. In this stage, undergraduate students of a local partner university support FIEMG in the quantitative and qualitative data survey relevant for the program, such as the generation of solid

and effluent residues, hot gas emission, feedstock usage, among others. Such mapping is made through questionnaires and visits to the industries. At this point, actions which fit the circular economy model already executed by the companies are surveyed.

The data surveyed are tabulated by FIEMG and the analysis of crossed information gives a start to the third and last stage of the program, named presentation and monitoring of collective business plans. The collective business plans (CBPs) are proposed by FIEMG and the partners in the program to the participant companies. Such plans involve more than two companies and aim at the reuse and implementation of resources derived from the productive process in others, as well as the reduction of operational costs and the improvement of the environmental indicators, the attraction of industries and investments to the region. Such actions are only examples of possible CBPs that, in last instance, contribute to the cooperation among the local industries and competitiveness of the industries from Minas Gerais.

The CBPs are executed by the companies by means of negotiations led by FIEMG and local partners. The decision and the terms of execution depend on the initiative of the participant companies. In this stage, the role of FIEMG and of the partner is to monitor and guide the companies, helping them in whatever they need. The negotiation must be set in the complexity of the plan, determined by the following main economic factors:

Existence of solution in the market – it is about the existence of a technology to provide synergy. Such existence will influence directly in the necessity of research and development of new processes, equipment and products, once it will imply a lower investment in tests, prototypes and analysis.

Acquisition of equipment or outsourcing services – it is about the necessity of acquisition of equipment for processing the resources or even the outsourcing of services, whether they are consulting, logistics, information technology or whatever the involved industries do not own for the concretization of the collective business plan.

Research and development – it is about the necessity of application of investments in research and development, in case there is no solution in the market for the concretization of synergy. The realization of tests, partnerships with consultants and such are collective investments.

Based on those factors, the level of investment and the deadlines for negotiating and concretizing the plans can be defined.

After the analysis of business plans and execution of the business rounds, the following results were obtained: in the industrial districts of both cities, Sete Lagoas and Uberaba, 44 companies took part of the circular economy program; 25 circular economy cases already applied by the companies were mapped; and 19 business plans in progress, which involved the negotiation of wood, composting, collective hygienization of wastes, metal scrap, effluents, collective quality water analysis, lamps and cardboard.

As result of the investments on the Programa de Economia Circular em Distritos Industriais by FIEMG, in two years of implementation, it can be noticed economic, environmental and social gains, either for the industries and for society. During the execution of the project, it could be noted: companies which raised their profit in 20%; the deviation of industrial garbage to landfills, increasing its useful time; total water reuse in processes; costs reduction with electric energy; reduction of greenhouse gases emission, such as CO₂, among others (FIEMG, 2018).

The results show the success of the program. However, it can be noticed, by the membership rate, the fear of some entrepreneurs in being part of innovative actions, by fearing the restrictions from law and tributary issues about the implementation of new business derived from CBPs, awhile the business core.

Thus, it is important that there are legal changes to encourage the development of sustainability actions and cooperation between companies.

The Política Nacional de Resíduos Sólidos (PNRS), main federal regulation for waste management, although it presents principles and guidelines common to the circular economy, neglects the opportunities for innovation brought by the model. It is necessary that the instrument be modelled to attend new trends and innovations and that it be translated into goals and tangible results for the sectors involved.

Besides the aforementioned, it is paramount to emphasize the importance of absorbing the culture of circular economy within corporations, so that actions transcend the reuse of waste and move towards new business models and product redesign to attend not only the needs of the production process, but also consumption. The final consumer can also benefit directly from circular economy, since products redesigned under this model can bring significant savings in the use of other associated inputs. For example, the decrease in the use of water in daily tasks, the reduction in the need for equipment maintenance and the incentive for the correct destination that allows the parts of the product to return to the high added value chain and not be discarded as waste.

The absorption of the concepts and the understanding of the model as an economic advantage are essential for the evolution of the productive process of industries within the circular economy model. At the moment, FIEMG's program focuses on solutions involving waste, effluents, supplies, utilities, in addition to the provision of collective services and attracting new businesses and investments to the region. However, the reverse cycle and ecodesign pillars are essential for the true transition to the circular economy, but they depend on the companies' culture to change to allocate capital for the development of new solutions within these concepts. Therefore, the medium- and long-term planning of the program is to return to the industrial districts worked to map opportunities for redesigning processes, products and associate production processes with reverse cycle strategies.

During the interaction with industries participating in the program, it was noticed that the entrepreneurs and collaborators have already been adapting to the reality of imminent rationing of water resources and other materials essential to the continuity of production. This was evidenced by the identification of 25 actions already in execution within the companies and also among them, focused on the circular economy concepts. In addition, it was noted the immediate interest of several actors in the subject, for identifying the economic opportunities within the subject. Therefore, it is expected that, over time, industries, which at first did not show significant interest in the subject or the program, will become partners and increase the range of collective business that can be implemented in the context of the industrial district and area of influence.

Finally, the analysis of the program execution proved itself as important for the development of improvement strategies to be applied in the next programs in other Industrial Districts of Minas Gerais. From the experience acquired throughout the three stages executed in Sete Lagoas and Uberaba, it can be seen that some adjustments are necessary to meet the expected indicators and, consequently, the success of the program.

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