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Original article

Action plan for the banking financial management of the photovoltaic panel value chain

Plan de acciones para la gestión financiera bancaria de la cadena de valor de paneles fotovoltaicos

Plano de ação para a gestão financeira bancária da cadeia de valor dos painéis fotovoltaicos

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ABSTRACT

In the current moments that Cuba is facing with respect to energy instability, it is necessary to take alternatives that allow minimizing the economic and social problems that this brings with it. The production of photovoltaic panels helps to a great extent to maintain the productive process in some hotel chains, companies, as well as the satisfaction of the needs of some families who have had the possibility to acquire this product in the market, etc. It is also a step forward in terms of pollution

reduction, since they work through clean and sustainable energy, thus eliminating the expulsion of carbon monoxide that causes great damage to the environment. The objective of this publication is to design an action plan for the bank financial management of the photovoltaic panel value chain.

Keywords: value chain; photovoltaic panels; banking system.

RESUMEN

En los momentos actuales que enfrenta Cuba hoy con respecto a la inestabilidad energética, se hace necesario tomar alternativas que permitan minimizar los problemas económicos y sociales que esto trae consigo. La fabricación de paneles fotovoltaicos ayuda en gran medida a mantener el proceso productivo en algunas cadenas hoteleras, empresas, así como la satisfacción de las necesidades de algunos núcleos familiares que han tenido las posibilidades de adquirir este producto en el mercado, etc. También resulta un paso de avance en cuanto a la reducción de la contaminación, ya que funcionan a través de la energía limpia y sostenible, eliminando así la expulsión de monóxido de carbono que provoca grandes daños al medioambiente. El objetivo de dicha publicación es diseñar un plan de acciones para la gestión financiera bancaria de la cadena de valor de paneles fotovoltaicos.

Palabras clave: cadena de valor; paneles fotovoltaicos; sistema bancario.

RESUMO

No atual momento em que Cuba enfrenta a instabilidade energética, é necessário desenvolver alternativas que permitam minimizar os problemas econômicos e sociais que isso acarreta. A fabricação de painéis fotovoltaicos contribui significativamente para a manutenção do processo produtivo em algumas redes hoteleiras e empresas, além de atender às necessidades de algumas famílias que conseguiram adquirir esse produto no mercado, etc. Também representa um avanço na redução da poluição, pois operam com energia limpa e sustentável, eliminando assim a liberação de monóxido de carbono, que causa danos significativos ao meio ambiente. O objetivo desta publicação é elaborar um plano de ação para a gestão financeira bancária da cadeia de valor dos painéis fotovoltaicos.

Palavras-chave: cadeia de valor; painéis fotovoltaicos; sistema bancário.

INTRODUCTION

At present, the Cuban economic reality demands that the results of the entrepreneurial system in the economic field be superior, with increasing levels of efficiency, effectiveness and productivity. In this sense, developing an effective management of business finances, as a key subsystem of business administration, is an imperative. It is necessary to develop research in response to the great challenge of seeking and applying new knowledge, procedures and tools to enhance it.

Productive efforts require planning, institutional coordination, setting priorities, allocating resources, implementing policies and measures, selecting instruments and defining indicators for monitoring the proposed objectives, as well as incorporating public banking to facilitate the required transformation processes and the creation of sustainable value as part of its social responsibility.

The value chain of photovoltaic panel manufacturing in Pinar del Río is of strategic importance in the fulfillment of one of the objectives of the country's sustainable development until 2030, which is to reach 24% of energy generation by means of alternative sources, in our case, solar energy.

In almost all the designs of the chains in Cuba, the banking sector is not included as an actor in them, nor as a regulatory body, supplier and coordinator of the sources of financing. It is vitally important to include the banking sector in the chains, since it is an external source of financing that enables the planning and development of each of the activities of the business system. The photovoltaic panel manufacturing chain in Pinar del Río is no exception, which is why it has been intentionally selected for this research, because of its importance in meeting one of the objectives of sustainable development based on the production, marketing and assembly of panels for obtaining clean and renewable energy.

Supply Chain Management is a philosophy that aims to coordinate the actors involved in the chain to synchronize all activities from the production stage to the delivery of the final product, in order to meet customer requirements, reduce costs and take advantage of opportunities to achieve a competitive advantage, all without neglecting a responsible environmental management. The sustainable development of organizations and their supply chains is fundamental and relevant in modern business and is based on the conservation of the environment, the satisfaction of social needs and the achievement of economic progress (Pupo Leyva et al., 2024).

The production-value chain can be defined, in general terms, as the set of activities involved in the design, production and marketing of a product or service. A more comprehensive definition of linkage may be that which refers to a broad sectoral and/or geographic interrelationship of companies engaged in the same or closely related activities. The linkage can be developed both "backward" (to suppliers of inputs and equipment, among others) and "forward" (activities developed jointly or connected, product collection, transportation, storage, marketing, processing, industrial processing).

Some authors sometimes identify the latter as "sideways" (processing and user industries, as well as closely related services and activities). This category includes important economic activities outside the municipal or provincial framework, which may even extend to external global value chains in search of collective efficiency. The linkages imply a degree of commitment between companies, beyond a normal purchase-sale relationship (Nova González et al., 2020).

The articulation of different business units in the process of value generation and the role played by each of the companies involved in it provides important elements in the design of business support policies that favor the generation of wealth through the consolidation of competitive advantages (Isaza Castro, 2008).

Porter (2007) states that it is the set of activities that are carried out when competing in a sector and that can be grouped into two categories: those related to production, marketing, delivery and after-sales service and the activities that provide human and technological resources, inputs and infrastructure.

The above definitions recognize that the value chain is a set of activities that are not independent, but are related to each other in order to increase added value and competitive advantage, seeking to transform inputs into products or services. This makes it possible to make decisions that make it possible to face different processes and create mechanisms that favor business growth (Lorenzo Kómova et al., 2021).

These definitions are taken as they express theoretically how the different activities that are put into practice in the development of the photovoltaic panel value chain are carried out, as well as the different processes that formalize business management.

Some definitions cited by García Martínez (2024) defend ideas related to management as a starting point. It becomes a necessity to give way to each aspect, which allows forming a structure close to the management of bank financing with a value chain approach.

Financing is the main way in which companies invest in those assets that are indispensable to fulfill their mission, so decisions related to this issue directly and indirectly affect their results. For entities to develop, grow and produce more, they must invest, which implies the involvement of bank loans (Rodríguez Sauleda et al., 2019).

One of the sectors most involved in the upgrading process has been the financial system. Although in the last decade measures have been taken to transform and strengthen its functioning, these have had discrete results or even setbacks. Although actions have been taken to expand the role of credit, boost the development of financial markets, stimulate greater bankarization and reorganize the financial system (Lage Codorníu & Cruz Simón, 2022).

According to Lorenzo Kómova et al. (2021), the management of bank financing is conceived as one of the support instruments that incorporates operational and organizational forms to contribute to the productive articulation of clusters or networks around the value chain. It is to facilitate the construction of competitive advantages arising from the interrelationships that are created and developed between companies and to promote conditions, mainly financial, for these to take place, as well as to implement mutually beneficial group actions.

It is important to consider the criterion of Aracil Fernández (2015) where he expresses that the distinctions between the terms sustainable, ethical or green are negligible and depend largely on personal appearance; each one defends a specific criterion. Ethical banking is an organization that offers banking products that combine financial profitability with ethical aspects in which it includes social and environmental factors. This definition is controversial as it can be misinterpreted to mean that a bank that does not operate in this segment is considered "unethical", which is not true, as ethics is present in organizations, leaders and workers and is not subject to regulation. However, its main characteristic is that all the products of this bank are ethical.

In general terms, a green bank is a tool that seeks to design and offer financing instruments and other support to promote green investments and contribute to the fulfillment of specific political goals (Ramos López & Roiz Jique, 2021).

Each of the authors coincide in their definitions of "green banking", stating that they are financial entities that finance renewable energy projects that improve environmental processes, promoting the development of a green planet, free of pollution. Green banks seek alternatives to reduce energy costs, encourage investment in the private sector and the different activities of the economy. There are several opinions that favor projects related to "green banking" as they allow a better management of natural resources, the reduction of pollution and the increase of projects that allow sustaining the economy with ideas that are not harmful to humans, as well as nature in general.

It is widely recognized that climate change and finance are closely linked, and that more funds are needed, but that a new approach is also required. Thinking about the problem of "green" finance in isolation is not helpful. It is imperative to rethink financing as an integral part of a new model of production and global insertion. This implies approaching differently to growth, so as to seek to generate value from a different perspective. Transforming finance implies modifying the current foreign investment regime. In addition, it is essential to rethink the role of investment in economic and social development, abandoning the idea that any increase in Gross Domestic Product is successful regardless of the cost (Stanley, 2021).

Another approach is required, overcoming the dilemma of a blocked horizon, which is associated with the short-termism that characterizes the current financial system. The financing needs linked to the fight against climate change must be observed, but also the financial costs of inaction. Managing uncertainty in the current context requires a methodological change that recognizes the impossibility of determining with certainty the dangers of inaction. But one that also condemns those actions that perpetuate an energy model anchored in the past, along with the financing that makes it feasible (Stanley, 2021).

The relationship between the bank and the company is conditioned by the structure of each one; the bank is the main source of financing for the business system and the company is the client that provides the most financing. Banks seek alternatives that allow the reduction of environmental pollution and an example of this is given by the investment in clean and renewable energy through the manufacture of photovoltaic panels, supported by the activities that make up the value chain in the manufacture of the same.

For these reasons, the objective of this research is to design an action plan for the financial and banking management of the photovoltaic panel value chain.

MATERIALS AND METHODS

The research has been directed by the dialectical-materialist method, which was of vital importance to support the new challenges imposed by the current conditions presented by the international and Cuban economy in its updating process and its link to the financing process of enterprises, taking into account the importance of including the bank as an actor in the value chain.

The systemic method was used as a theoretical method, which allowed the provision of the general orientation to fulfill the general objective, from the realization of an analysis of the financing process of the value chain of photovoltaic panels, through the application of the analysis-synthesis and the development from the general to the particular.

Participatory action research was used, as a form of collective introspective inquiry, undertaken by the participants in certain situations, in order to improve their practices and understand their impact in a given context, supported by actions planned and evaluated continuously and jointly, with the commitment to involve everyone in the solution of the present problems.

In addition, the following empirical methods were used: observation to verify the reality of the process under study, as well as the qualitative diagnosis of the situation to be investigated. As part of the application of these methods, documentary analysis was used to evaluate and classify the bibliographic material compiled in relation to the different conceptions of value chains, with the aim of analyzing the support of these conceptions in Cuba through legal regulations, taking as a basis the regulations in force in the banking system, among other documents.

RESULTS AND DISCUSSION

In the designs of the chains in Cuba, it is not common to include the banking system as an actor in them, as a regulating body and provider of the sources of financing required for the development of the different productive activities, despite the fact that many of the points related to the lack of inputs and access to technologies are due to the lack of financing, problems inherent to the banking system and financial institutions.

The photovoltaic panel manufacturing chain in Pinar del Río is not an exception, so it has been intentionally selected for this research, due to its importance for the country, in the fulfillment of one

of the objectives of sustainable development until 2030, which is to reach 24% of energy generation through alternative sources, in our case, solar energy.

The relationship between the Credit and Commerce Bank (BANDEC) and the Electronic Components Company, which manufactures photovoltaic panels in Pinar del Río, Cuba, and which can be analyzed as a starting point in conducting this research, can be analyzed as existing because of its own structure, because of the activities they have in common, because of the need for financing of the company itself to be able to carry out the activities that make up the value chain.

The existence of the bank allows maintaining the projection of flows that show the present and future conditions, increasing the economic capacity to make investments in the short, medium and long term. All this allows the relationship between both entities to be strengthened through the receipt and sending of information that allows maintaining the link, as well as the fulfillment of the different functions that support the achievement of a common objective (account statements, deposits, check copies, transfers, transaction receipts, investment requests, among others).

The possibility of innovations allows the creation of new mechanisms and procedures that favor the economic and financial management that gives answers to the own needs of the Components Company, to the society and to the environmental and financial problems existing in the country in a general way. The economic growth of the Electronic Components Company can be applied through the approach of the workers belonging to BANDEC as the closest banking institution to this entity, which would favor the economic-financial stability, would diminish the economic risk, which is currently constant, propitiated by the scarcity of financing, the presentation of scientific works in innovation events that allow giving solutions to the current problems, as well as recognizing the bank as an actor of the value chain.

The Electronic Components Company of Pinar del Río cannot sustain itself, it needs external sources of financing that can propitiate a balance in its economy, so they have decided to make alliances with other institutions that, under the conditions of the same, finance the purchase of raw materials for the production of photovoltaic panels. The solution lies in reducing the financial limitations, creating mechanisms for development, giving priority to the fundamental activities that sustain the economic and social development of the country, as well as the society that conforms it.

This research contributes to the need to change the country's energy matrix, specifically to the photovoltaic panel manufacturing chain. In 2001, the production of photovoltaic panels began, with a power of five watts and after an investment process, 60,000 panels were produced annually until 2019, with a total capacity of 15 MW, increasing by 65% (Rojas Hernández et al., 2023).

For this increase, the supply of raw material and equipment was arranged with Chinese companies under the conditions of a government loan. The raw material brought from China guaranteed the production of the Electronic Components Company, the only Cuban plant capable of producing these panels, located in the western province of Pinar del Río, thus constituting an important support for Cuba's aim to reach 24% of the national electricity generation through the use of renewable energy by 2030, achieving the integration of environmental thinking into the design of a product (Rojas Hernández et al., 2023).

The manufacture of photovoltaic panels has designed a value chain through a methodology that is in the phase of socializing the contents with the different actors, the search for solutions to their financial problems and their insertion in the market, as well as perfecting process costs and value drivers. The delay in the consolidation of these mechanisms has caused a stagnation in the process of value creation and the definition of sources of competitiveness, preventing progress in satisfying demand and the impossibility of implementing technological progress (Figure 1).

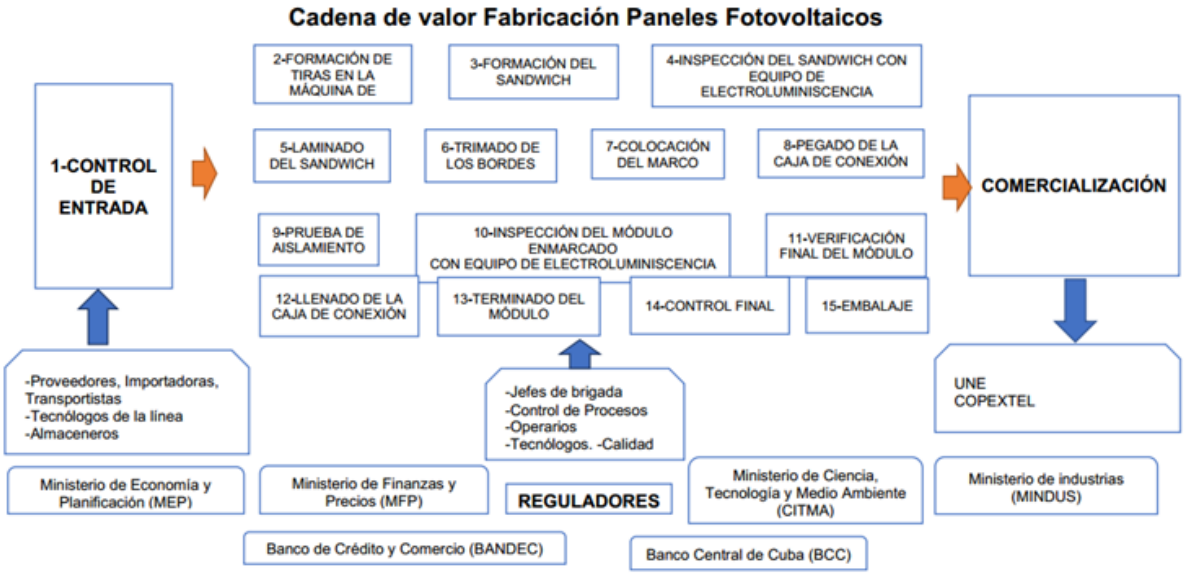

Figure 1. Value chain of photovoltaic panels

Source: Espinosa Martínez et al. (2023)

The foreign trade scheme through Cuba Electrónica is not functional, due to the disconnection with the interests of the factory. In the mechanisms of allocations of Liquid Capacity, LC (in Spanish), to honor the Letters of Credit, as well as the allocation of the countervalue in Cuban Pesos, is where the greatest delays in the process and lack of liquidity to operate to meet the contracted deadlines, mechanisms where the Central Bank of Cuba and the International Financial Bank intervene (Espinosa Martínez et al., 2023).

The references presented in relation to banking and the business system recognize the high dependence between the both for their development and impact on society, which is made more complex by the business structures in the form of value chains. Banks are their main source of financing, and companies are their main clients and the ones that contribute the greatest profits.

Developing an action plan would facilitate the search for banking solutions to improve the value chain for the manufacture of photovoltaic panels.

In this sense, the action plan is structured as follows:

Action No. 1: Conduct a value chain analysis identifying key players, processes, bottlenecks and opportunities for improvement.

Objective: Conduct a comprehensive diagnosis of the current value chain of photovoltaic panels.

Deadline: 1 month.

Resources required: Material resources for training.

Action No. 2: Identification of provision of financial options for the purchase and installation of solar systems such as loans, leasing or subsidies, use of trust funds and implementation of government policies that facilitate investment in solar energy.

Objective: Identify different financing alternatives appropriate to the Cuban context.

Deadline: 1 month.

Resources required: Financial and technological resources.

Action No. 3: Establish alliances to strengthen collaboration between BANDEC and universities, research centers and companies in the energy sector to promote the development of joint projects that improve the value chain and the efficient use of natural resources offered by clean and sustainable energy, thus eliminating environmental pollution.

Objective: Establish strategic alliances that enhance the value chain of photovoltaic panels.

Deadline: Up to 6 months.

Resources required: Financial and technological resources.

Action No. 4: Development of new computer programs that favor new technologies to meet the needs of clients in terms of speed of procedures, as well as the ease of carrying out financial operations, including greater use of financial flows that allow the speed of reconciliations and transactions of the different operations.

Objective: To update the computer programs that enhance the development of the photovoltaic panel value chain and its financing alternatives.

Deadline: 6 months to 1 year.

Resources required: Financial and technological resources.

Action No. 5: Decrease interest rates for those credits that are requested for photovoltaic panel manufacturing and assembly projects and that bank interests are charged from the arrival of raw materials from abroad.

Objective: Decrease interest rates for investment in photovoltaic panels.

Deadline: Pending approval.

Resources required: Human resources.

Action No. 6: Implementation of a system to monitor the impact of activities carried out in the value chain through the creation of working groups to adjust strategies according to the results obtained.

Objective: Evaluate the financing of the photovoltaic panel value chain.

Deadline: 3 months.

Resources required: Financial and technological resources.

Action No. 7: Implementation of banking products that combine financial profitability with social and environmental factors.

Objective: To introduce new banking products based on the improvement of the photovoltaic panel value chain.

Deadline: Pending approval.

Resources required: Financial and technological resources.

Action No. 8: Make investments in infrastructure to enable the expansion, installation and distribution of photovoltaic panels, ensuring that there is an efficient logistics chain.

Objective: Invest in infrastructure for the installation and distribution of photovoltaic panels.

Deadline: Up to 5 years.

Resources required: Financial and technological.

The implementation of the proposed action plan brings with it a number of advantages, including the following:

1. Increased energy accessibility: to facilitate financing and training, which will allow more people and companies to access solar energy, reducing dependence on non-renewable energy.

2. Creation of working groups: to facilitate the creation of working groups by banks, which would help organize the structure for the management and financing of the value chain for the manufacture of photovoltaic panels.
3. Development of new banking products: promoting research and development of new banking products stimulates innovation in solar technology, which could lead to the creation of solutions adapted to local needs.
4. Improving environmental sustainability: promoting solar energy contributes to the reduction of greenhouse gas emissions, helping to combat climate change and promoting a cleaner environment.
5. Strengthening the energy sector: by diversifying energy sources and promoting the use of renewable energies, the country's energy security is strengthened and vulnerability to fluctuations in fossil fuel prices is reduced.

In light of the above, it can be concluded that the fundamental ideas on value chain allow to know that it examines in depth the activities of a given entity to understand its costs, current sources and competitive advantage over the competition. It is a tool that allows the optimization of processes in an efficient way, the increase of production, as well as the ease of decision making.

Banking is called upon to facilitate the required transformation processes and the creation of sustainable value as part of its social responsibility. It is a global trend for banks to seek alternatives that allow the reduction of environmental pollution, investing in clean and renewable energy through the manufacture of photovoltaic panels.

The activity that BANDEC implements to improve the value chain of photovoltaic panels will not only benefit the energy sector, but will also have a positive impact on the economic, social, and environmental development of the country.

The alliances between the bank and the company will allow the development of the different activities, as well as the updating of the different processes that will allow the chain to advance.

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Conflict of interest

Authors declare no conflict of interests.

Authors' contribution

José García Martínez and Anisley Herrera Pineda participated in the bibliographic search, study design, data collection, and manuscript preparation.

Yudelmis González Blanco, Mario Nahiroby García Chávez, and Yadisbel Arencibia Rivera participated in the study design, data collection, and manuscript preparation.

All the authors reviewed the writing of the manuscript and approve the version finally submitted.