
Eco-friendly startups as innovative solutions to reduce environmental pollution - A presentation of successful international experiences

**المؤسسات الناشئة الصديقة للبيئة كحلول ابتكارية للحد من التلوث البيئي -
عرض لتجارب دولية ناجحة-**

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Abstract :

This study aims to highlight the concept of start-ups, which are Eco-friendly start-ups, by addressing their concept, advantages and the most important challenges facing their development as an innovative tool that allows contributing to reducing environmental pollution and achieving the concept of a sustainable green economy, by presenting some successful international experiences in this field.

Among the most important results of the study that Eco-friendly start-ups, also known as green start-ups, are an effective tool in reducing environmental pollution and contributing to providing a sustainable economic environment. These projects have proven their effectiveness in many countries of the world, especially in light of the technological developments taking place.

Key words: start-ups, green economy, Eco-friendly innovation, environmental pollution.

JEL classification codes: Q5,M13

1. Introduction

Attention to the environmental aspect has become one of the priorities of countries around the world because of its impact on the future of their economy and to preserve the rights of future generations by contributing to achieving the concept of sustainability at all levels, especially economic ones, and the transition towards a green economy. In light of the increase in the consumption of fossil energy and other energy sources, and thus the pace of greenhouse gas emissions increased, which led to an increase in the percentage of environmental pollution and various climate changes, and in light of this, innovation in technologies related to projects, especially those emerging in an Eco-friendly manner, has become one of the basic factors in reducing Environmental pollution and achieving sustainable economic growth.

Both emerging and developed countries are seeking to adopt Eco-friendly start-ups. Many countries have achieved successful experiences in this field by achieving the most important goal, which is reducing environmental pollution and shifting towards a green economy.

Therefore, the following problem can be raised:

What is the reality of Eco-friendly start-ups as an innovative tool to reduce environmental pollution?

To answer the main problem, the following hypotheses can be put forward:

- Industrial pollution is the main factor of environmental pollution.
- Green startups indicate the transition from a high-carbon economy to a green economy with lower carbon emissions.
- Green startups face many challenges that hinder their development, most notably the financing problem.

This study also aims to:

- Identify the characteristics of green startups.
- Identify the most important successful countries' experiences in the field of green startups.

- Address the most important challenges that hinder the role of green startups in contributing to environmental sustainability and the transition to a green economy.

2. Concepts about Eco-friendly startups

The concept of green start-ups is based on two basic concepts: green business and start-ups. There are also many advantages that distinguish them from other institutions and that give them great importance in achieving the goal of sustainability and reducing environmental pollution.

2.1. Definition of Eco-friendly startups: There are many definitions of Eco-friendly startups, including:

- **Green startups are:** organizations that focus primarily on finding effective solutions to environmental problems. They are driven by the goal of sustainability, aiming to reduce environmental impact through innovative products and services. They aim to reduce damage to the environment for a greener planet.(nf, 2024)

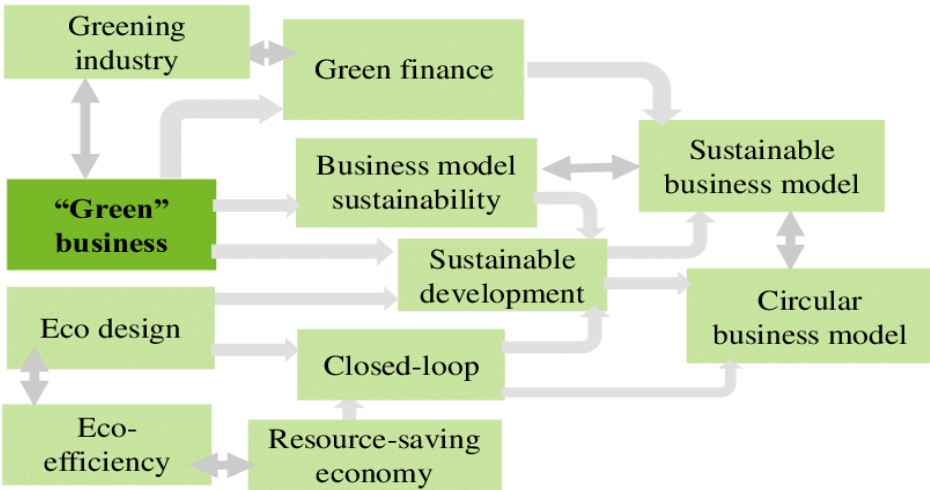
- **Isaak's definition:** An ec-o-entrepreneur is someone who seeks to transform a sector of the economy toward sustainability by starting a business in that sector with green design, with green operations and with a lifelong commitment to sustainability in everything that is said and done.(OECD, 2011)

- It is: organizations that adopt Eco-friendly policies and practices, and this may mean reducing waste, recycling materials, using renewable energy sources, or investing in green technologies. Many companies are now incorporating sustainable practices into their operations in order to attract environmentally conscious consumers and help preserve the environment.(nf, What is a Green Company?, 2024)

- A green company provides goods and services that help create a more sustainable environment. In a sustainable world, current demands are met without compromising the ability of future generations to satisfy their own. Because of this, a green company is often described as a long-term business that does so without harming the environment, the economy, or the local community in any way.(Mukul Bhatnagar, 2022, p. 257)

From the above, we find that “green startups” are not only an innovative tool and a means of achieving growth, but they are also sustainable. This is through the products and services they offer, through an effective and serious contribution to achieving the goal of sustainability at the present and future, whether it is converting energy systems from traditional to renewable, protecting the climate, avoiding ocean pollution, or achieving access to the circular economy. However, the term “green” does not only cover environmentally sustainable products and services, but also includes a wide range of diverse sustainable solutions to social challenges. As the following figure shows:

Figure 1: Evolution of green business and related concepts.



Source:(Inga Uvarova, 2021, p. 3)

Thus, the definition of, green startups are based primarily on the idea of preserving the environment and not polluting it, by recycling it in their production processes, and working on energy conservation to achieve the goal of sustainability, by relying on the element of innovation..

2.2. Characteristics of green startups: Relying on green startups has a significant impact on the transition to a sustainable green economy, which has a positive environmental impact by focusing their activity around products and services that contribute to this.

The characteristics of these green startups are represented in the following three points in particular : (Bergset & Fichter, 2015, pp. 121-122)

– **Product-related characteristics:** Product characteristics: Here the question arises: Are the products of the start-up's goods and services Eco-friendly or not? Eco-friendly products are classified based on the environmental impact of the products and an analysis of the extent of the negative impact resulting from their use.

– **Characteristics of entrepreneurs:** How Can Entrepreneurs Green Their Startups? Many studies have focused on the extent to which entrepreneurs can green their startups based on their qualifications and ability to develop and manage them effectively.

– **Characteristics of the strategy:** Characteristics related to the strategy: The question here is: How can the strategy increase the ability of the start-up to achieve environmental friendliness? The strategy followed by start-up institutions to achieve their goal of sustainability is based on the coherence and coordination of the efforts of the internal parties of the institution and external actors such as investors.

2.3. The importance of Eco-friendly start-ups : can be summarized in the following points :

– **Environmental Importance:** Green startups contribute to building a more sustainable future. They help reduce carbon emissions, preserve biodiversity, and promote a circular economy through waste management and recycling, which promotes environmental sustainability and protects natural resources..

– **Economic Importance:** Green startups have become pivotal in promoting a sustainable economy, by creating new jobs, attracting local and foreign Eco-friendly investments, and reducing environmental costs to the economy.

– **Social Importance:** Eco-friendly emerging institutions are now providing sustainable products and services in order to reduce environmental pollution, which reflects on the health of individuals and communities, by enhancing environmental awareness and social responsibility.

2.4.Types of Eco-Friendly Startups: Startups can be divided into three types, the most important of which are Internet startups, as follows :(Čalopa, Horvat, & Lalić., 2014, pp. 24-25)

-The first type of startups is called “Tech Startups or the Automizer” :

Tech startups are companies that develop and commercialize new technologies. These companies typically focus heavily on research and development, and their success depends on their ability to create innovative products or services that solve real-world problems.

- The second type of startups is called “ Social Startups ” :

Social startups are companies that aim to solve social problems. These companies typically focus heavily on social impact, and their success depends on their ability to create sustainable solutions that meet pressing needs in their communities.Targeting small and medium enterprises.

- The third type of startups is called “ Sustainable Startups or the challengers ” :

Sustainable startups are companies that aim to create lasting positive change. These companies typically focus heavily on environmental or social sustainability, and their success depends on their ability to create products or services that help people live better lives without harming the planet.

Green startups also have many advantages, including :(Monga, 2018, p. 435)

- Reducing energy costs: This is done by relying on renewable energy strategies, efficient use and smart technology, and relying on Eco-friendly start-ups improves energy efficiency and recycles wasted energy..
- Improving employee productivity: Eco-friendly start-ups create a healthy and sustainable work environment, provide moral and material incentives, and prevent companies from incurring losses during workers' vacations, which contributes to enhancing the balance between work and personal life.

- Gaining or enhancing competitive advantage by relying on innovative strategies, which enhances the brand image and increases customer loyalty.
- Making the world a safer and healthier place by reducing environmental impacts and practicing corporate social responsibility.

3. An analytical look at the most important successful experiences in the field of Eco-friendly startups

Startups are witnessing a significant expansion regardless of the country or city in which they are located. These startups are usually just starting to develop a specific product or service. Due to the early stage of the company's life cycle, they often rely heavily on financial support from investors or loans from banks and usually work with a small team, often only the founders themselves. One of the important factors for the success of a startup is the ecosystem in which it operates. These ecosystems usually consist of multiple types of individuals and organizations that interact with each other and influence the startup.

Through this study, we will discuss the most important green startups in the world that have been successful and are considered experiences that can be benefited from by other startups .

3.1.Top Countries Leading the Way for Green Startups in 2024:

As concerns about carbon emissions, climate change, and the future of our world continue to grow, protecting our environment is becoming more important every day. To help, a number of excellent sustainability companies have emerged. Indeed, the environment and sustainability industry is expected to reach \$60.7 billion by 2027, growing at a CAGR of 27.8%.

The following table shows the top 10 green startups for 2024:

Table 01: Top 10 Green Startups in the World 2024.

ranking	institution	discreption
1	SINAI Technologies Location: San Francisco, California	It is a sustainability startup based in San Francisco, California. It is considered one of the top 10 sustainability startups for 2024. The company seeks to develop innovative solutions aimed at reducing negative environmental impact

		and promoting sustainable practices across various sectors.
2	Lasso Ring Location: San Mateo, California	It is a green startup company focused on providing innovative solutions in the field of environmental sustainability. The company seeks to develop environmentally friendly technologies that aim to reduce waste and promote recycling, which contributes to preserving natural resources and reducing the carbon footprint.
3	EcoCart Location: San Francisco, California	It is a green startup based in San Francisco, California, that aims to promote environmental sustainability in the e-commerce sector, by providing innovative technology solutions that reduce the environmental impact of online shopping operations.
4	Biome Makers Location: Sacramento, California	Sacramento-based Biome Makers is tackling the big problem of sustainable agriculture. Its patented B-Crop technology enhances soil health by harnessing the power of microbial networks. The company is dedicated to providing innovative solutions to improve soil health and boost agricultural productivity.
5	SWITCH ENERGY	It is a Dutch company, A company specialized in installing high quality solar energy systems and providing maintenance and support.
6	FREYR ENERGY	It is an Indian company, is one of the leading companies in the field of solar energy.
7	Azure Construction Location: Los Angeles, California	Azure creates ADUs and backyard studios on residential properties using recyclable materials, advanced 3D printing technology, and a modular construction process. Clients can choose from smaller studios that can be converted

		into anything from a meditation room to a painting studio to larger units that can accommodate beds and bathrooms.
8	HYDROGENONE Location:London	It is an investment company that finances clean hydrogen.Through a diversified portfolio to mitigate climate pollution.
9	CARBO CULTURE Location: Helsinki, Finland	Private company using proprietary climate technology to remove carbon from biochar, By removing billions of tons of carbon dioxide from the atmosphere.
10	PHOTANOL BV Location:Amsterdam, Netherlands.	Biotechnology company This company captures emitted carbon dioxide to produce renewable chemicals while leaving fossil resources in the ground.

Source :Prepared by the researcher based on:(Gresheen Libby, 2024)(Websites of the following companies:photanol, hydrogenone, freyrenergy, switch energy)

To further elaborate on successful global experiences in the field of green start-ups that aim primarily to reduce environmental pollution, we will look at the experiences of India and Germany.

4. India’s Experience with Green Startups:

The Indian economy is intricately linked to the success of the startup ecosystem, and the country’s economic outlook remains optimistic, with a projected CAGR of 6.3% (according to IMF data) in 2023-24. The government’s continued support for the tech ecosystem has been reiterated in Budget 2023, which includes programs such as tax breaks and the Drone Shakti program. The long-term outlook remains promising, with the IMF projecting the Indian economy to grow to become the third largest in the world by 2027. A slight increase in investment activity is expected in the coming years as the global economy stabilizes, further strengthening India’s position as a leading country and investment destination par excellence.(Jain, 2024)

4.1. Factors that help green startups emerge in India: There are a set of components that help countries succeed in the green startup experience in India, which are as follows: - Industry: Known as the Fourth Industrial Revolution, it is a fundamental step towards integrating and upgrading industries through the use of new technology. It is a concept that aims to improve production and eliminate waste, thus supporting sustainability elements. Industrial methods have recently been developed to promote the circular and green economy, as the latter converges with the goal of the circular economy at the economic and environmental levels. The transition to a green economy includes the efficient and effective use of natural resources, energy and new technology, which leads to economic development and job creation. Adopting a successful green economic model requires a global commitment and a strategic framework for global investment through digitizing operations and innovation that helps mitigate financial risks associated with Eco-friendly institutions.(Ali, Anufriev, & Amfo, 2021)

4.2. Impact of Green Startups in India:

India has witnessed a rapid growth in green startups in 2024, as the Indian government has become increasingly aware of the importance of green startups in terms of goods and services provided. Sustainability is no longer an option for startups; it has become essential for long-term success. By achieving environmental sustainability through innovative solutions, promoting circular economy principles, and ensuring access to green finance, India is developing sustainable solutions in energy to achieve sustainable and Eco-friendly economic growth. Some of the key areas where India is receiving more attention than others include:

- **Renewable energy:** India aims to be one of the world's largest renewable energy markets by reaching 450 GW of renewable energy capacity by 2030. In 2024, India saw the listing of over a dozen renewable energy and electric vehicle companies, including Waaree Energies, a solar panel manufacturer to invest in solar and wind power to reduce reliance on conventional energy, and Ola Electric Mobility, an electric bike manufacturer to promote renewable energy use, and contribute to promoting sustainable mobility solutions.

- **Sustainable construction and smart cities:** by relying on Eco-friendly building materials such as greenjams and improving urban planning.

- **Water resources management for environmental sustainability:** by focusing mainly on improving water use efficiency, desalination and reuse.(EIMR, 2024)

4.3. Financing green startups in India:

The Indian startup sector has become the focus of international investors, thanks to the rapid growth of the sector. This sector in India has become a new alternative to attract investors, which prompted the government to provide a set of incentives for green startups in India, in order to contribute to efforts to mitigate the effects of climate change.

Reliance on patient capital (investment strategies that provide social and environmental returns in addition to financial returns with a focus on long-term returns, while long-term investment horizons or smaller financial returns may be inherent in individual patient capital investments, none of these conditions are required in long-term capital investments.

There is also dedicated assistance for startups in the science and technology sector, with the government acting as a primary buyer and corporates as secondary buyers, in addition to grant funding and blended capital to support and stimulate green activity and green development.(Global Institute Digital Globalization The New Era of Global Flows, 2024)

4.5. Reasons for the Green Revolution in India: The Green Revolution in India responded to acute food shortages, population growth, and the urgent need to boost agricultural productivity. Thus, the rise in green startups in India can be attributed to several factors. One major factor is the growing awareness of environmental issues and climate change. With India struggling with severe pollution and scarcity of resources, India has set up agricultural research banks and centers such as the Indian Agricultural Research Institute to develop

high-yielding crops using modern technology and advanced agricultural methods.

India's rich pool of innovative entrepreneurs is playing a pivotal role in this green revolution, and they are increasingly drawn to developing sustainable solutions that address the country's pressing environmental challenges.

India has been paying attention to the clean energy sector, offering several incentives that allow green startups to grow. The green tech market has been expanding rapidly with companies developing solutions to reduce pollution in India, particularly agritech, which is one of the largest sources of global environmental pollution. Some of the key factors that have helped the sector grow and expand include:

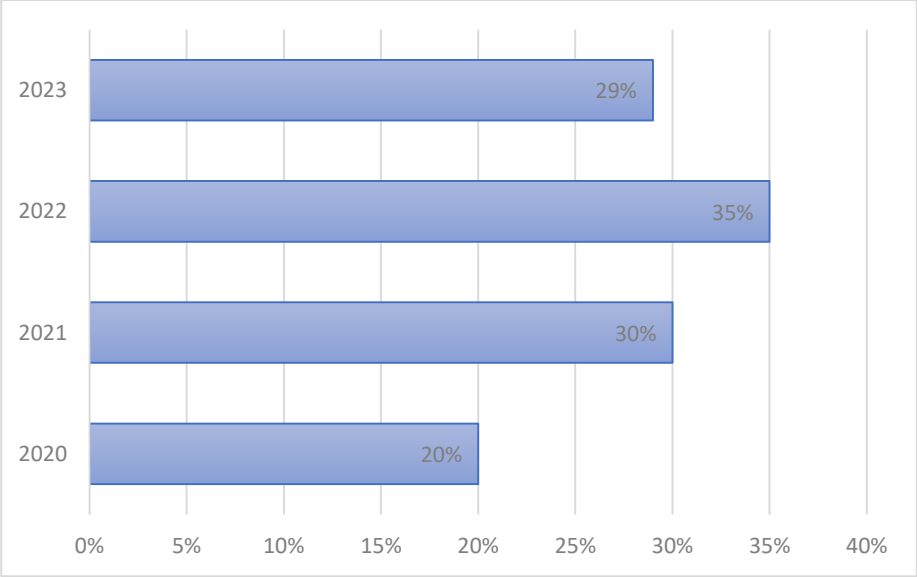
- Government support and incentives provided by the government through tax exemptions for owners of green startups;
- Increasing the level of environmental awareness of the Government of India;
- Availability of the demand side for the use of clean energy in the field of startups, which is represented by the investor category in particular;
- Ability to obtain investment capital and the necessary financing for clean sectors;
- Opening the field for institutional startups to rely on clean energy through partnerships and cooperation with external stakeholders;
- Technological progress and expansion of their local capabilities in the field of clean energy and innovations.(S.P.Deepika, .Balamurali, & Dagli, 2024)

5. The German experience in the field of Eco-friendly start-ups:

Start-ups and entrepreneurs play an important role in developing the economy and raising its innovative capacity, in addition to the flexibility provided by these companies and the ability to enhance competitiveness, as most new entrepreneurs focus their activities in the field of digitization and information technology. Germany is considered among the leading countries in the field of Eco-friendly

start-ups, and its percentage has increased in recent years, as we can see from Figure 2.

Figure 2: Share of German green startups during the period-2020) (2023



Source :Prepared by the researcher based on: Fichter. Et al, Green Startup Monitor [Rapport]

From Figure 2, we find that the slight decrease in the percentage of green startups could be related to the current tense market and financing environment, where companies’ strategy is adjusted in a short time..

5.1. Advantages of green startups in Germany:Advantages of green startups in Germany: In light of the rapid developments and progress recorded by the economies of many countries in the world, startups play a pivotal role in maintaining the distinction of the German economy in the context of the great competition witnessed by the global market. European countries compete in encouraging and financing startups, but Germany greatly outperforms in the number of these companies, especially environmentally friendly ones. Sustainability in Germany is also supported by strict laws and regulations aimed at protecting the environment and preserving

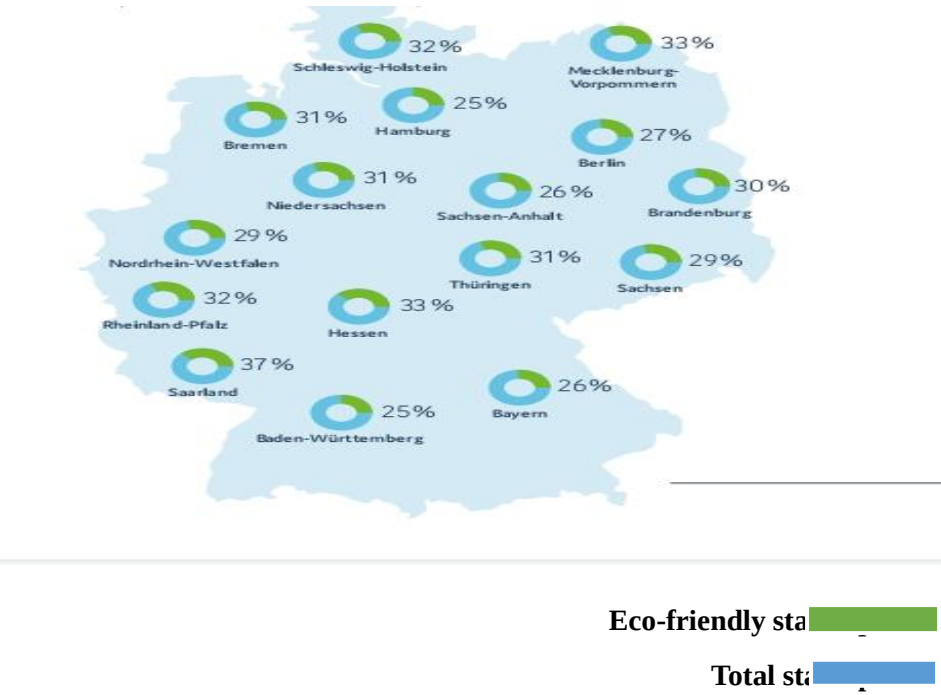
natural resources. Among the most important advantages of green startups in Germany are:

- The German government is working to provide a more supportive legal and regulatory environment for startups, in addition to encouraging private investment in these companies.
- It supports green startups through new financing programs and consultations, in addition to practical laws, enhancing diversity in talent acquisition, and strengthening the role of founders and innovators in startups.
- Stimulating competition in new sectors such as technology, renewable energy, and digital services. The function of startups is not limited to innovation only, but also contributes to improving the investment environment in Germany, as venture capital and the trend towards financing startups contribute to enhancing economic development and achieving sustainable growth.
- German universities act as a vehicle for raising awareness about the importance of green startups, hosting nearly a third of all green startups in the R&D sector. To encourage environmental conservation and make it a political goal. Despite the optimism surrounding the initiative, its success depends on the actual implementation of the announced measures and the continuation of cooperation between the government and investors. Startups will also need to adapt to ongoing economic challenges, such as inflation and rising interest rates.

5.2. Geographical distribution of green startups in Germany:

Green startups in Germany have managed to capture a large share of the total startups in the country, and are geographically distributed across the country, with a noticeable concentration in some geographical areas. which also provides a second look at the ideal location for international companies wishing to launch a green company in Germany. From Figure 3, we find that the state of Saarland has a disproportionately high percentage of 37%, followed by the state of Mecklenburg-Vorpommern with 34% and then the state of Hesse with 33%. The rest of the states, as shown in the figure below, range from 32% to 25%. (Fichter & al, 2024, p. 9)

Figure 3: Geographical distribution of green start-ups in Germany for .the period 2018-2023

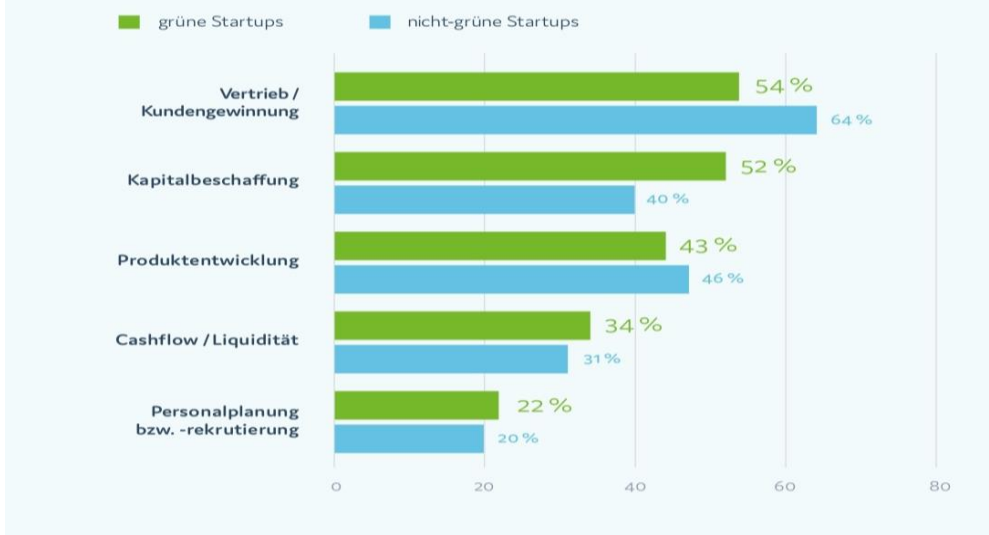


Source : (Fichter & al, 2024, p. 9)

5.3.Challenges of green startups in Germany: Customer acquisition, capital raising and product development are the most important challenges facing green startups,However, financingis one of the most significant challenges facing green startups. Customer acquisition, capital raising and product development are the most important challenges facing green startups. As we can see from Figure 4.

While green startups tend to find it easy to acquire customers (54%), they are more likely to have problems raising capital (52%). This shows that green solutions are still in demand during the crisis, but financing in this sector still poses specific difficulties.

Figure 4: Financing of green startups in Germany in 2023.



Source : (Fichter & al, 2024, p. 9)

6. Conclusion

Green startups have become an important part of economic activity, and interest in them has increased from both developed and developing countries, due to the positive impact of this type of organization in driving economic development, as it is characterized by modernity and adoption of new ideas.

The study reached a set of results, the most important of which are:

- Green startups work to provide solutions to reduce environmental pollution, by providing green products, providing new sources of energy generation, etc.
- India relies on patient capital to finance green startups.
- Green startups constitute a large part of the total startups in Germany.
- There are still many challenges facing green startups, most notably the problem of financing.
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