

[DOI: 10.20472/EFC.2020.014.002](https://doi.org/10.20472/EFC.2020.014.002)

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ECO-INCLUSIVE ENTREPRENEURSHIP: ADDRESSING CLIMATE CHANGE THROUGH TECHNOLOGICAL INNOVATION. THE CASE OF CLEANTECH INDUSTRY

Abstract:

The article covers the role of entrepreneurs in developing climate-resilient solutions and business models for sustainable development with a special focus on technological innovation. Building on the concept of social entrepreneurship, the research attempts to investigate the role and the reasons that explain entrepreneurs' engagement in climate change mitigation and in developing new eco-inclusive technologies. The focus will lay on the case of the cleantech industry by attempting to provide a definition of the industry, an analysis of the typology of the financing involved the sectors with the largest impact, and the most innovative types of projects. The results are meant to anticipate key directions and serve as a possible guide to future entrepreneurs and investors interested in cleantech businesses.

Keywords:

Eco-inclusive entrepreneurship, cleantech, social entrepreneurs, sustainable entrepreneurship, climate change

JEL Classification: L26, O44, O13

Introduction

Traditionally, environmental aspects were perceived as additional, burdensome and unprofitable costs for most businesses. Global changes over the past decades have come along with imperative resource scarcity, high pressure coming from the constant change in consumer preferences and a new societal mindset, making sustainability and environmental protection great business opportunities. Approaching social and environmental issues no longer has to be unprofitable, it might actually be “the 21st century model for enviable growth” (Brusson, 2019). Additionally, as the challenges become more complex and go beyond single governmental intervention, private initiatives are expected to uphold, accelerate and scale up sustainability. Worldwide, scientists, academics and governments are seeking solutions for highly demanding environmental and social challenges, but a growing number of voices state that in solving this equation entrepreneurs are the ones will have to play a critical role.

The current paper aims to outline the role of entrepreneurs in developing climate resilient solutions and business models for sustainable development with a special focus on technological innovation. The first part of the article attempts to address the reasons that explain the involvement of entrepreneurs in climate change mitigation, plus the role entrepreneurs can play in tackling climate change and in developing technologies by referring to the concepts of social entrepreneurs. In the second part, the focus will lay on the case of the cleantech industry by attempting to provide a definition of industry, the typology of the financing involved, sectors with the largest impact, and the most promising trends for the industry nowadays. The last section synthesizes data from several reports regarding financial allocations directed to diverse cleantech businesses in order to underline the geographical distribution of investments in cleantech projects and the main sectors which attract financial resources. In the last part of the research, we have selected the most innovative types of projects trying to anticipate key directions, serving as a possible guide to future entrepreneurs and investors interested in cleantech businesses.

Conceptual framework

The economic literature has embraced several concepts meant to describe the new typology of entrepreneurs that tackle social issues in all the various forms and consequently a set of different classifications have been elaborated by referring to the motivation, type of objectives or issues addressed by entrepreneurs.

One of the most wide-spread concepts is the one of **social entrepreneurship**, developed to describe entrepreneurs concerned with social transformation through innovative resource reconfiguration (Alvord et al., 2004) and characterized by a socially driven leadership and a solid ethical fibre (Mair and Marti, 2006). According to OECD, social entrepreneurs target primarily the social impact rather than profit maximisation and manage through innovative business models to develop new markets, generate new sources of income and contribute to sustainable and inclusive economic growth.

Social entrepreneurship can be broadly defined as a process that includes a set of successive steps starting with the identification of a social problem, designing targeted solutions and

evaluating the likely social impact, along with developing the business model from a sustainable perspective. Robinson (2006, p. 95) considers that there are two main options for a social business model: either the “creation of a social mission oriented for-profit or of a business-oriented non-profit entity that pursues the double (or triple) bottom line”. El Ebrashi (2013) also frames a range of elements needed to create an executable process of social entrepreneurship that shall address “opportunities to eliminate social and institutional barriers, market failures related to the provision of public goods and distributional equity; clear social outcomes and impact; and some specific indicators to measure the success of the organization through achieving social impact” (p. 203).

Fowler (2000) adds to the profile of a social entrepreneur the simultaneous concern about economic activities along with a positive social outcome and “creating horizontal, vertical, forward or backward economic linkages” (Fowler, 2000, p. 645). The perspective proposed by Seelos & Mair (2005) focuses on the creation of market effects through “new models for the provision of products and services that center directly to basic human needs that remain unsatisfied by current economic or social institutions” (Seelos and Mair, 2005, p. 243). By looking at the very scope of social entrepreneurship, Banodia and Dubey (2017) consider that social entrepreneurs are actually catalysts for social transformation and play the role of ‘change agents’. Since social entrepreneurs usually target highly insoluble social problems that are underserved by governmental policies and lack financial support, their activity implies high risk and limited resources (MacMillan and Thompson, 2013).

Zahra et al. (2009) frame a classification of social entrepreneurs that comprises *three types of social entrepreneurs* that are different in the way they identify social opportunities, in their impact on society, and in the way they assemble the needed resources to pursue these opportunities: **bricoleurs, constructionists and engineers**. The concept of *social bricoleurs* was inspired by Hayek’s (1945) theoretical framework who considers that “entrepreneurial activities can only be discovered and acted upon at very local levels” (Zahra et al., 2009, p. 524), therefore social bricoleurs are those entrepreneurs that perceive and act upon opportunities to address a **local** social need for which they have the expertise and resources to do so. Social bricoleurs are mostly motivated to support their own communities’ social wealth, they are not concerned to upscale their solution and therefore their activity can be difficult to locate or to monitor (Zahra et al., 2009, p. 524). Meanwhile, in the case of *social constructionists* the main incentive is to create easily scalable businesses along with social wealth within larger social systems (Zahra et al., 2009). Thirdly, the theoretical background for the typology of *social engineers* is of Schumpeterian (1942) inspiration because for this kind of entrepreneurs creative destruction is the main instrument in fixing social issues. Social engineers recognize social problems and aim to solve them at a larger scale via ‘revolutionary change’. Social engineers also face a particularly difficult challenge because ‘the nature of the reforms they introduce are usually a threat to the interests of established institutions and are sometimes seen as subversive and illegitimate’ (Zahra et al., 2009, p. 526).

An adjacent concept is the one of **environmental entrepreneurship**, defined as ‘the process of discovering, evaluating and exploiting economic opportunities that are present in environmentally relevant market failures’ (Dean and McMullen, 2007, p 58). Embracing to some extent the previously mentioned two concepts, **sustainable entrepreneurship** describes business

initiatives with both environmental and social drive. Sustainable entrepreneurship refers to the process of exploring, evaluating and capitalizing on economic opportunities which detract from sustainability but not necessarily environmentally related or even environmentally relevant (e.g. negative externalities, defective pricing systems).

The cleantech industry – an overview

Definitions of what the cleantech industry actually encompasses vary among academics, business practitioners and policymakers from broad and comprehensive ones to others narrowly focused. The term was originally coined by the venture capital investment community approximately two decades ago and has been ever since associated with a wide range of technologies and practices or with similar terms such as sustainable technology, “green tech”, “enviro-tech” or “green energy”. According to *CleanTech.Org*, “cleantech is wider than all the mentioned synonyms and is in fact “an umbrella term encompassing the investment asset class, technology, and business sectors which include clean energy, environmental, and sustainable or green, products and services”.

Probably one of the most cited definitions of cleantech would be the one provided by the *Cleantech Group*: “Clean is more than green and should not be confused with the terms environmental technology or ‘green tech’. Cleantech is about new technology and related business models offering competitive returns for investors and customers while providing solutions to global challenges. Cleantech addresses the roots of ecological problems with new science, emphasizing natural approaches and is driven by productivity-based purchasing, and therefore enjoys a broader market economics, with greater financial upside and sustainability”. Similarly, *Cleantech Venture Network* defines the concept as a “diverse range of products, services, and processes that are inherently designed to provide superior performance at lower costs, greatly reduce or eliminate environmental impacts and, in doing so, improve the quality of life. Clean technologies span many industries, from alternative forms of energy generation to water purification to materials-efficient production techniques”.

When it comes to the concernment of the cleantech industry, *Ecotech Québec* states that the contribution lays in “significantly reducing negative impacts on the environment (environmentally effective), offering users superior performance at a lower cost (economically superior) and helping to improve quality of life by optimizing resource use (socially responsible). Following *VentureOne’s* methodology, companies included in this industry are those that “directly enable the efficient use of natural resources and reduce the ecological impact of production”. Burtis et al. (2004) add the economic stake of the sector by considering that it compresses “products and services that use technology to compete favourably on price and performance while reducing pollution, waste, and use of natural resources”. Bjornalia and Ellingsen (2014) follow the same approach and consider that “the importance of cleantech start-ups lies in their mission to protect the environment by facilitating the increased use of clean energy and environmentally friendly solutions”. In a more through-going perspective, Segelod et al. (2011) consider that the cleantech industry “signals something that is about to become a fourth ecologically oriented industrial transformation wave of creative destruction”.

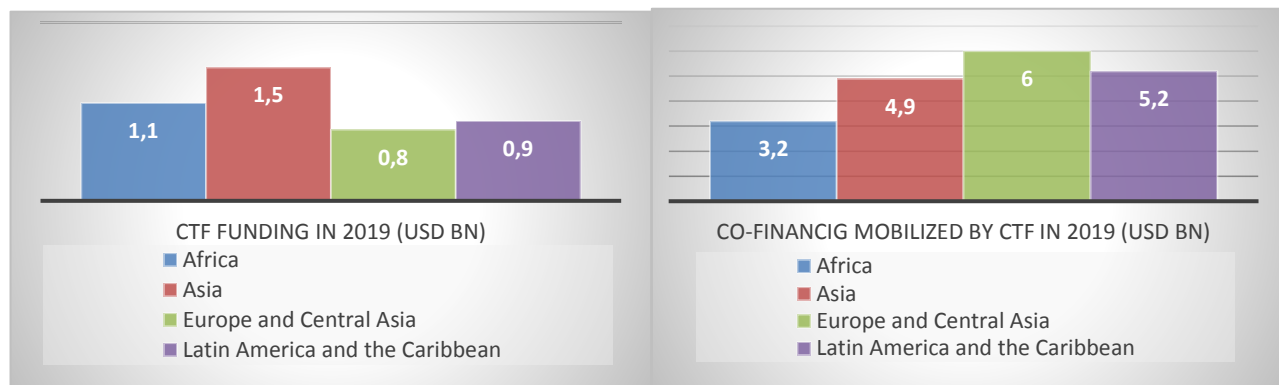
Results

In this section we synthesize data included in several reports, regarding financial allocations directed to diverse cleantech businesses. Our purpose is to underline the geographical distribution of investments in cleantech projects and the main sectors which attract financial resources. In the last part we select the most innovative types of projects trying to anticipate the future directions, serving as a possible guide to future entrepreneurs and investors interested in cleantech businesses.

The World Bank established the Clean Technology Fund (CTF) aimed at directing financial resources to the development and implementation of low-carbon technologies as to determine the reduction of greenhouse gas emissions. The overall contribution reached USD 5.69 billion in September 2020, the first contributors being United Kingdom (31.46%), United States (26.22%), Japan (18.56%), Germany (10.8%) and France (4.67%) according to World Bank (2020). The projects funded by CTF are located in developing countries around the world: there are 14 projects in Africa, 25 in Asia, 17 in Europe and Central Asia, 29 in Latin America and the Caribbean and 1 single global project (Climate Investment Funds, 2020).

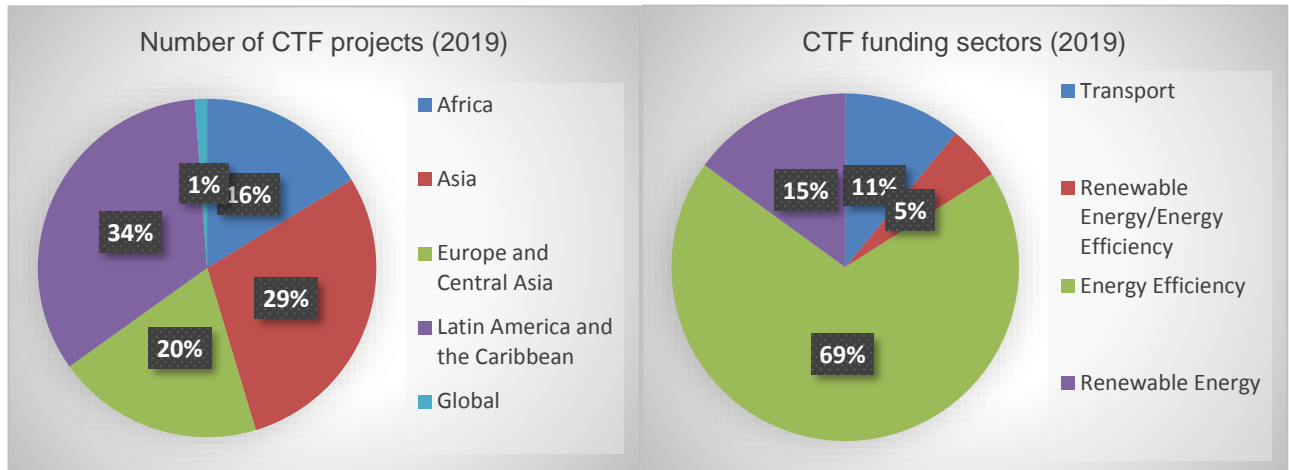
In Figure 1 we present the main data describing the Clean Technology Fund results in 2019, showing projects' distribution and total value by continent and main sectors of destination. The largest amount of financial resources went to Asia, Eastern Europe and Central Asia together. In terms of distribution by sector, predominantly financed was the energy efficiency one.

Figure 1: Clean Technology Fund results by region, 2019 (1/2)



Source: *Climate Investment Funds (2020)*

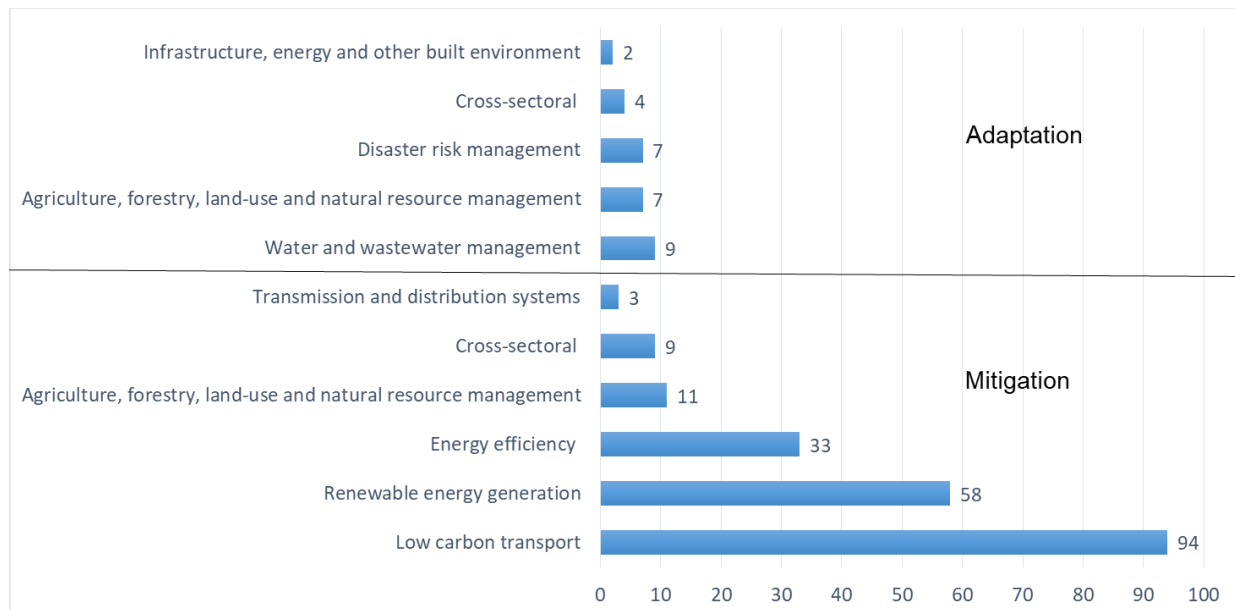
Figure 1: Clean Technology Fund results by region, 2019 (2/2)



Source: Climate Investment Funds (2020)

The report developed by Climate Policy Initiative (2019) distinguishes between climate finance targeting *mitigation* (of greenhouse gas emissions) and *adaptation* (minimizing the risks and prejudice already produced as a result of climate change). According to this report, the finance attracted for mitigation reached USD 537 billion in 2018 (93% of climate finance), while for adaptation USD 30 billion. The mitigation finance focused mainly on renewable energy production, low carbon transportation and less on energy efficiency. In the case of adaptation, finance was more equally distributed to water management, natural resource management, disaster risk management and so on (Figure 2).

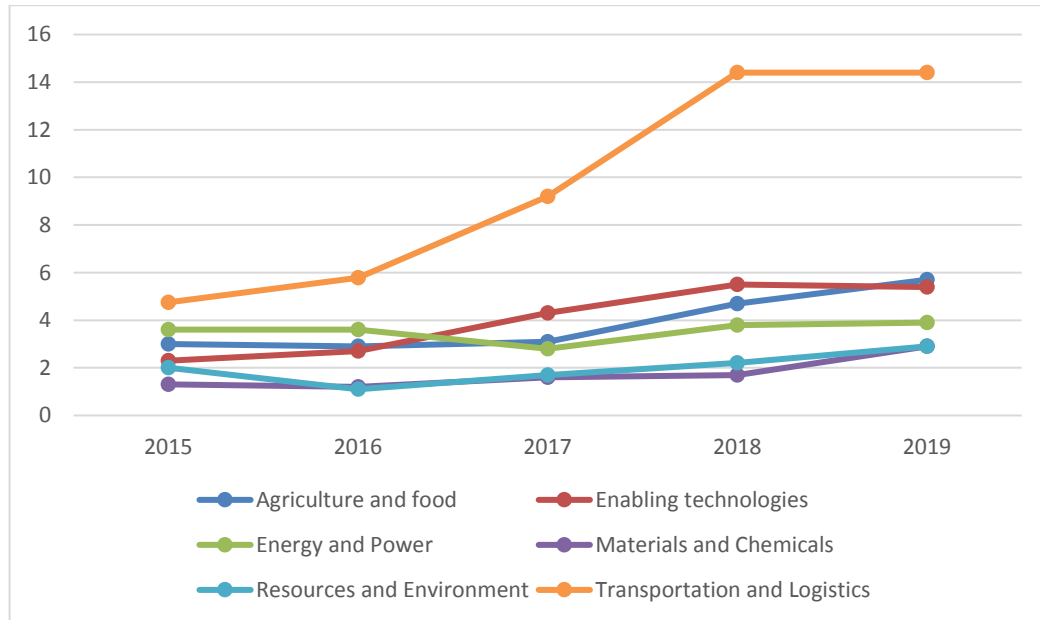
Figure 2: Climate finance (USD billion, average value between 2017 and 2018)



Source: adaptation from CPI Report (2019)

Cleantech Group elaborated a ranking of the first 100 companies that are expected to achieve the most prominent market impact in a future period ranging from five to ten years. The ranking is based on an evaluation made by several experts in the field (investors and representatives of other companies) using the following criteria: the ability to innovate, the characteristics of the market they approach and the ability to transpose their innovations into marketable products.

Figure 3: Venture capital investments (USD billions)



Source: Cleantech Group (2020)

Figure 3 presents the venture capital investment evolution in cleantech companies selected by the *Leading companies and themes in sustainable innovation report* issued by Cleantech Group (2020). The data covers the period between 2015 and 2019 and six economic sectors. The sector that received the highest level of investments throughout the whole period was transportation and logistics, also having the highest increase in investments in the five years interval (from USD 4.75 billion to USD 14.4 billion). For the other sectors, the investment value in 2019 is similar, ranging from USD 2.9 billions (materials and chemicals and resources and environment) to USD 5.7 billion USD (agriculture and food). All sectors have attracted more investments in 2019 compared to 2015, although in the case of ‘energy and power’ the increase was of only 8.33%, while for transportation and logistics there has been a 203% growth.

Table 1 comprises the main business activities of the companies in each of the six sectors. These are companies which innovate in many different ways, but their common factor lays in the constant preoccupation for cost reduction, increasing performance, climate change resilience and the preservation of natural resources.

Table 1: Main business activities of companies from Cleantech top 100

| Sector | Main business activities of companies from Cleantech top 100 |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Energy and power | Energy storage, energy efficiency, clean energy. |
| Agriculture and food | Urban vertical farms or indoor farming systems, nutrition from organic waste or through methan conversion, innovative and green technologies to improve productivity in agriculture (biotechnology, use of data analytics and AI). |
| Enabling technologies | Developers of data analytics, machine learning and other enabling technologies supporting firms to achieve their sustainability goals |
| Materials and chemicals | Building sustainable alternative materials, renewables and improving products' performance and cost parameters. |
| Resources and environment | Developing materials and solutions for lowering consumption of natural resources and pollution, developing technologies for monitoring air quality, for reducing the environmental impact of resource extraction (i.e. in mining). |
| Transport and logistics | Electric vehicles production and support technologies, software developers for optimization in logistics. |

Source: authors' compilation based data from the Cleantech Group (2020) report.

Despite of growing preoccupations for climate change, world carbon dioxide emissions have increased by 14.87% between 2009 and 2019, by an almost constant annual growth rate. Within the same period, the renewables consumption has increased by almost 252 % and the renewable power generation by 340% (B.P., 2020). So, despite of this growth in production and consumption of green energy, the increasing pollution rate shows an ever growing demand for energy at world level. In fact, primary energy (including renewables) consumption per capita was 7.83% higher in 2019 as compared to 2009 worldwide, at a growing population (B.P., 2020). All this elements undoubtedly indicate an overall growing market for renewables and cleantech products.

Conclusions

Social entrepreneurship plays an important role in addressing social, economic, and environmental challenges while fostering growth, prosperity, and social inclusion. Entrepreneurial initiatives are no longer exclusively driven by financial gains; social recognition and the opportunity to provide innovative solutions for pressing social and environmental problems are also strong enough incentives. Nevertheless, there is a clear tendency in the entrepreneurial environment to shift from a non-profit orientation towards a profit oriented approach that will provide critical resources to create innovative solutions to social and environmental problems instead of focusing on providing financial resources.

The multifaceted and comprehensive cleantech industry is yet a young, highly promising field. Even if not yet largely significant in terms of investments, the market is upwards growing as concerns regarding environmental issues, especially climate change are more prominent and stringent

Acknowledgment

This work was cofinanced from the European Social Fund through Operational Programme Human Capital 2014-2020, project number POCU/380/6/13/125015 "Development of entrepreneurial skills for doctoral students and postdoctoral researchers in the field of economic sciences".

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