Chapter 24
The Role of Renewable Energy Consumption in Promoting Sustainability and Circular Economy:
A Data-Driven Analysis

Lucio Laureti
Lum University Giuseppe Degennaro, Italy

Alessandro Massaro
Lum University Giuseppe Degennaro, Italy

Alberto Costantiello
Lum University Giuseppe Degennaro, Italy

Angelo Leogrande
Lum University Giuseppe Degennaro, Italy

ABSTRACT

In this chapter, the authors investigate the role of "renewable energy consumption" in the context of circular economy. They assume that the consumption of renewable energy is a proxy for the development of circular economy. They use data from the environmental, social, and governance (ESG) dataset of the World Bank for 193 countries in the period 2011-2020. They perform several econometric techniques (i.e., panel data with fixed effects, panel data with random effects, pooled ordinary least squares [OLS], weighted least squares [WLS]). The results show that "renewable energy consumption" is positively associated among others to "cooling degree days" and "adjusted savings: net forest depletion" and negatively associated among others to "greenhouse gas (GHG) net emissions/removals by land use change and forestry (LUCF)" and "mean drought index." Furthermore, they perform a cluster analysis with the application of the k-Means algorithm and find the presence of four clusters. Finally, they compare eight different machine-learning algorithms to predict the value of renewable energy consumption.

DOI: 10.4018/979-8-3693-0049-7.ch024

INTRODUCTION

In the following chapter we analyze the role of renewable energy consumption in the context of the circular economy with attention to environmental sustainability. The reasons that prompted us to tackle this analysis consist on the one hand in the empirical evidence of the existence of climate change (Nordhaus, 2013) and on the other hand in the international economic policies that increasingly push states to invest in the green economy. Finally, it is necessary to consider the role of economic science, which has always warned about the negative externalities generated in connection with pollution (Pigou, 1920). Certainly, there is a link between economic growth and environmental pollution that has characterized the historical development of capitalism (McGuire, 2020), (Hanlon, 2020). Even in Europe, at the origins of capitalism, pollution generated by industrialization destroyed rivers (Whelan, et al., 2022), forests, polluted cities and destroyed entire populations. Awareness about the need to introduce green oriented policies into capitalism is therefore not just a trend of generation Z (Hurrelmann & Albrecht, 2021) but rather a real long-term need either in Western civilization either in global civilization (Meadows, Meadows, Randers, & Behrens, 2018).

Renewable energies have received public and private financial support either in developing and industrialized countries (Mazzucato & Semieniuk, 2018). However, there are many doubts about the possibility of relying totally on the energy efficiency of renewables. In fact, many countries that have a high GDP-growth rate continue to pollute. The use of non-renewable forms of energy and the related CO_2 production are inextricably and positively associated to economic growth. It is therefore difficult to propose to newly industrialized, poor and underdeveloped countries, especially in Asian, a transition to renewable energy without losing at least partially the ability to growth in terms of GDP. In fact, the need to escape from poverty, underdevelopment, ignorance, and hunger could overshadow the environmental and renewables issues in many low-income countries.

Furthermore, the current state of technological knowledge does not allow for the creation of renewables that can fully replace non-renewable energies. However, it is very probable that in a medium-long term it will be possible to increase the efficiency of renewables. In this regard, the issue of energy storage plays a crucial role. Furthermore, new discoveries in the physical field could lead to the knowledge of new energies, such as dark energies, connected to dark matter, which could open up absolutely new and unpredictable energy scenarios. It is therefore probable that investments in green-tech can make renewable energies much more advanced and efficient in the future, creating the conditions for a reduction in the use of non-renewables.

Certainly, in the scientific literature presented in the chapter, the idea of the existence of the Environmental Kuznets Curve-EKC is often promoted. The EKC is a type of curve that describes the transition to a more sustainable economy through the increase of per capita income. The EKC curve is an inverted U-shaped curve. In the beginning, per capita income and pollution grow together to a maximum. Beyond the maximum point, the further growth of per capita GDP generates a reduction in pollution. The EKC is not free from criticism and skepticism. At an ideal level it could be understood as a theoretical reference. But, it is also true that, many highly developed countries, such as the USA for example, have levels of pollution and CO_2 emissions that are still very high despite the growth of the GDP. It is therefore clear that the application of the EKC is not a historical necessity, but rather the consequence of environmental economic policies.