INTEGRATED ASSESSMENT MODELS (IAMs) APPLIED TO CLIMATE CHANGE AND ENERGY TRANSITION

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ABSTRACT:

The current climate change is due to the increased concentration of greenhouse gases (GHGs) in the atmosphere as a result of human activity. The large number of factors and variables that, directly or indirectly, affect GHG emissions, as well as the multiple and complex relationships between them, makes it more difficult to decide upon the best actions to take to curb or alleviate climate change and the analysis of the consequences that each decision brings with it. This has led to the development of complex simulation models called Integrated Assessment Models (IAMs) or Energy-Economy-Environment (E3) models, focused especially on climate change. The development and use of these models to guide policy decisions on climate change has grown in recent years, as highlighted in the reports of the Intergovernmental Panel on Climate Change (IPCC). This work is a panoramic review of the main existing IAMs and discusses their main features. The article focuses especially on analyzing the limitations of current IAMs, which should drive future developments towards these tools.

Keywords: integrated assessment models; climate change; system dynamics; energy

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1. - INTRODUCTION

Concern about climate change and its link to the necessary energy transition is increasingly present in our society, so scientists, policy makers and intergovernmental institutions are focusing their efforts on how to deal with these great challenges. To assist in decision-making to address these issues, scientists from a wide range of fields, from physics and chemistry to economics, engineering or sociology, collaborate to develop Integrated Assessment Models (IAMs).

An IAM is a numerical simulation tool designed to help understand the relationships between a large number of technological, economic, environmental and social variables that characterize the development of our society. Models built from historical data allow you to simulate future scenarios with different alternatives of action to guide decision-making. In recent years, these models have been applied, in particular, to the search for alternative solutions to climate change and the energy transition. To address these complex problems, an IAM requires knowledge to be integrated from a wide range of areas: climatology, economics, engineering, sociology or politics, seeking to represent the interactions between human beings and the environment.

IAMs began to develop in the 1970s with the pioneering World3, developed by a team led by Donella and Dennis Meadows and from which the report "The Limits of Growth" was obtained [1]. The goal of the World3 model was to understand better global behavior based on different subsystems, such as population, food production, pollution or consumption of non-renewable resources, in order to be able to propose policies to correct the unsustainable trends observed in the continuity scenarios. From then on, different IAMs appeared. At the end of the same decade, Willian Nordhaus developed a model showing atmospheric emissions and CO_2 concentrations [2], which would result in 1992 to the DICE (Dynamic Integrated Climate-Economy) model [3]. The DICE model already completely integrated economic and climate systems, and was rewarded in 2018 with the Nobel Prize in Economics.