



Contents lists available at ScienceDirect

## Renewable and Sustainable Energy Reviews

journal homepage: [www.elsevier.com/locate/rser](http://www.elsevier.com/locate/rser)

## Mapping research on carbon emissions trading: a co-citation analysis

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## ARTICLE INFO

## Keywords:

CET  
Review  
CiteSpace  
Visualization analysis  
Quantitative

## ABSTRACT

Carbon emissions trading (CET) is a market mechanism, aims to promote the control of globe greenhouse-gas emissions. It is an important part of international environmental cooperation and it is also the important application research filed of environmental economics and institutional economics. There is a very obvious phenomenon that the publications about CET increasing year by year. This paper adopts the scientometric analysis method to assess the current state and explore the development trends of carbon emission trading domain based on the literature data retrieved from Web of Science. The research results of this paper could answer the following questions clearly. 1) Which subject category is the most popular in CET research area? Which journal published the most number of articles in this area? Which institution and country is the most productive in CET domain? 2) What are the major research areas and what documents are the most cited? Which journal are the most representative in CET research domain? 3) What are the new emerging trends and development in CET research area? On the whole, the research method in this paper provided a fresh research approach to assess the performance of CET research. The findings may help for the new researchers to pick out the most relevant articles, journals, institutions and seize the research frontier in CET field.

## 1. Introduction

Nowadays, environmental and resources problems have become increasingly prominent, the sea level rising and energy depletion problem, seriously restricting the development of human society. In this background, the world must unite to control global greenhouse gas emissions so as to jointly cope with the environment problem and the survival crisis [1]. Various measures have been designed to curb carbon emissions, such as carbon emissions trading (CET), carbon tax and so on [2,3]. However, the CET has been widely recognized as one of the most effective measures to reduce the carbon emissions [4]. It is a very flexible market mechanism rather than a compulsory regulation to control and regulate the carbon emissions [5]. In Sadegheih's work, the genetic algorithm (GA), tabu search (TS), mixed-integer programming (MIP) and simulated annealing (SA) are used to CET program problem and the corresponding computational results are also presented [6]. Zhu et al. [7] proposed a useful stochastic integer programming model to the CET planning problem, a real case about CO<sub>2</sub> emissions problem of Beijing's electric power system is presented to validate the proposed model. Liao et al. [8] employed the Shapley value to investigate the initial allocation problem of the carbon emission allowances. Jiang et al. [9] further investigated the construction of CET scheme in

Shenzhen city, China.

The current global carbon trading market is based on the Kyoto mechanisms and mainly includes two kinds: one is project-oriented and the other is quota-oriented. Currently, the second phase of the EU-ETS (European Union Emission Trading Scheme) will continue to be implemented as planned [10]. NZ ETS which is launched by New Zealand in 2008 is expanded in 2010. Other developed countries such as Japan, Australia and South Korea are positively preparing for their own carbon emissions trading system. The turnover as well as the volume of the carbon-trading increase significantly in the past few years. The data from the World Bank shows that the overall trading amounts in 2008 is 91 billion euros and it jumped to 140 billion euros in 2012. There can be no doubt that the carbon emissions trading market is one of the most prospect commodity trading market [10].

Despite the growing importance and publication numbers of CET, very little research has addressed analyzing the current state and the development trends of CET domain. Scientometrics is the quantitative analysis of input, output and process for scientific activities based on mathematical statistics and computing technology and other mathematical methods, it is the discipline aims to find out the rules of scientific activities [11,12]. In the last few years, it seems that a lot of researchers are interested in using the scientometric method to find out

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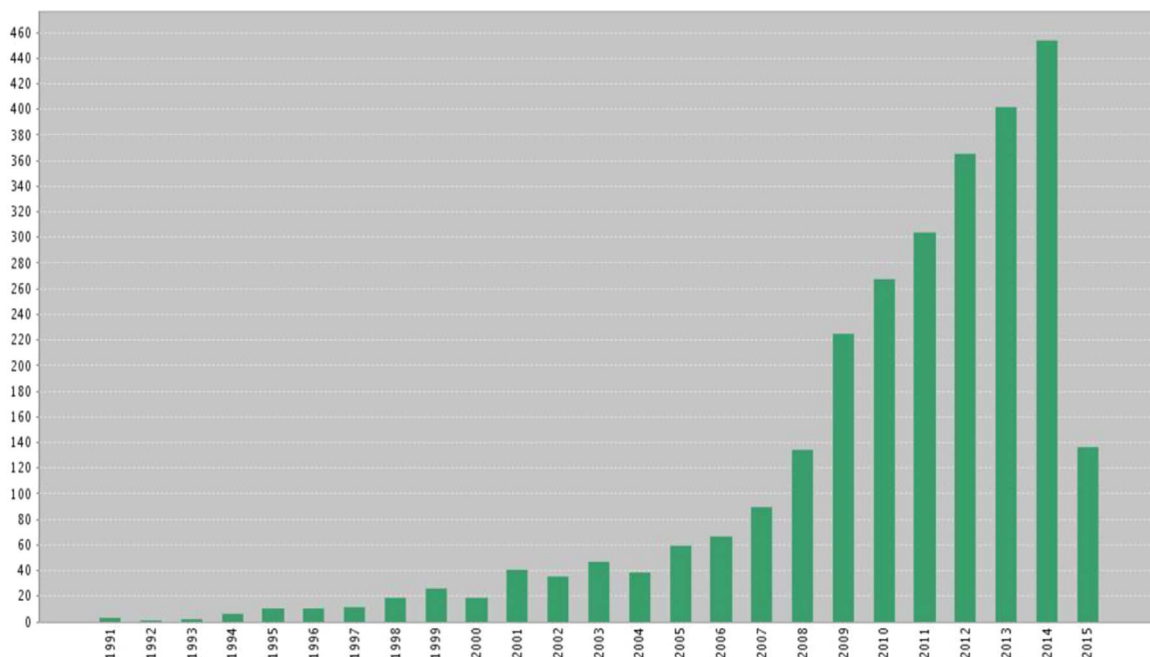


Fig. 1. Number of publications in CET area from 1991 to 2015.

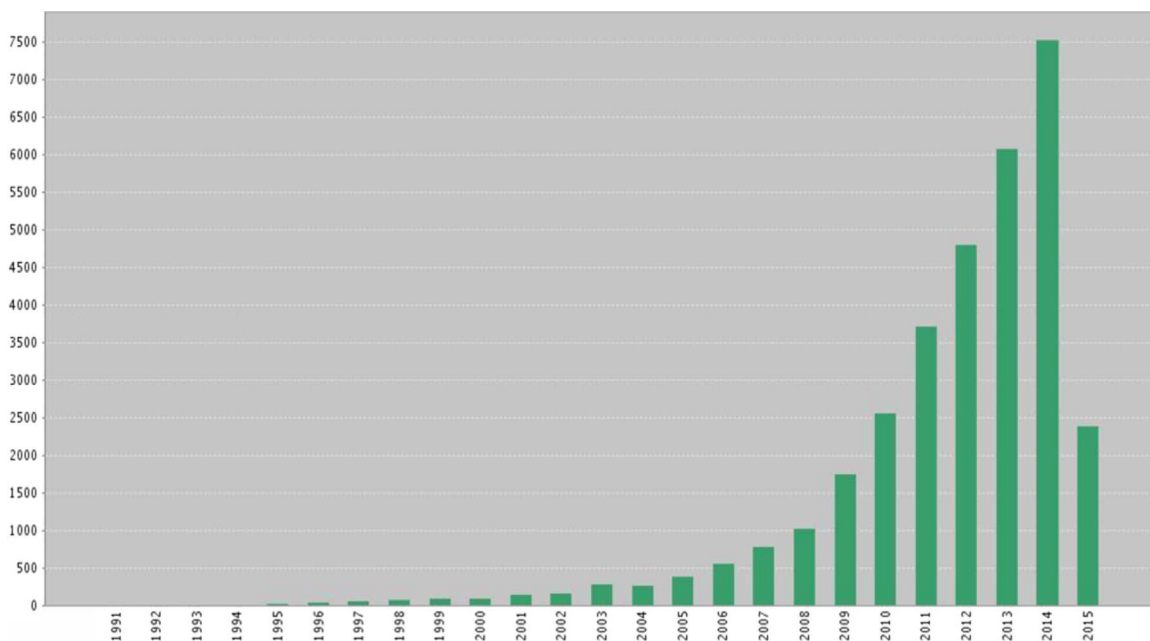


Fig. 2. Number of citations per year in CET area from 1991 to 2015.

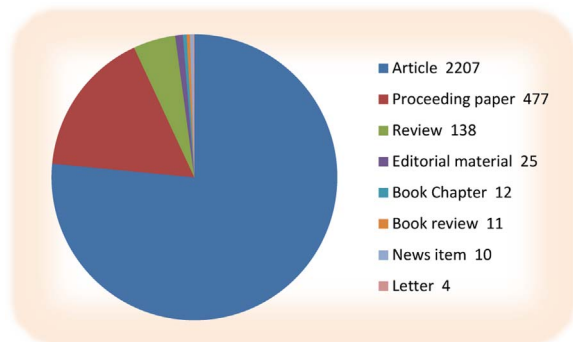


Fig. 3. Documents types in CET area from 1991 to 2015.

the phenomena and regularities in regarding domain. Hu et al. [13] applied the scientometric methods to analysis the current status and future research trends in electric vehicle research domain. Kim and Chen [14] made a scientometric review in recommendation systems domain and found out the emerging trends and new approaches for research. Siegmeier and Möller [15] through the adoption of descriptive scientometric measures studied the organic farming and bioenergy problem to reveal the development, structure and distribution of this domain. CiteSpace invented by Dr. Chen Chaomei from Drexel University is a very efficient and powerful scientometric method [16–18]. It is written by Java language and designed for analyzing the co-citation networks through the visual form [19]. Citespace has been received many attention from scholars in recent years [20,21]. Wei et al. [22] applied the CiteSpace to discover the most influential papers

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