

Mapping Carbon Tax: Bibliometric Analysis and Visualization of Relevant Research

Inova Fitri Siregar^{1*}, Rinayanti Rasyad², Nurhayani Lubis³, Indarti⁴, Dini Onasis⁵
{inova@unilak.ac.id¹, nurhayanalubis@unilak.ac.id³, indarti@unilak.ac.id⁴, onasis@unilak.ac.id⁵}

Department of Economic and Business, Universitas Lancang Kuning, Pekanbaru, Indonesia

Abstract. The main problem with why the carbon tax was introduced was the negative externality impact caused by the activities of the products manufactured by businesses. Nevertheless, the carbon tax may minimize the impact of negative externalities. One of them is the risk of climate change, for instance, the rising level of flooding and the existence of drought will exacerbate the scarcity of clean water due to climate change. Several indicators of bibliometric analysis, such as network visualization, are presented in this study. Research methods related to bibliometric analysis for Carbon Tax's topics involve collecting data from relevant bibliographic sources and analyzing existing publications to identify trends, patterns, and author contributions in the field. The subsequent research opportunity is that One of the tools for policy can be a carbon tax to accelerate the transition and reduce greenhouse gas emissions in China. Meanwhile, one of the biggest producers of greenhouse gases is the United States. in the world and has a major impact on climate change. The United States government has also noticed that many other countries are implementing carbon taxes and increasing the use of clean energy, so it does not want to be left behind in terms of innovation and clean technology development. The limitations of this study consist of the uncertainty of the economic impact. Even though a lot of research has been done on the economic impact of carbon tax, there is an inherent uncertainty in accurately measuring the effect.

Keywords: Carbon Tax, carbon pricing, carbon emissions, bibliometric analysis, trends

1 Introduction

Global energy consumption is projected to continue to escalate in the future, primarily due to population growth and economic development in various countries [1]. The expectation is that energy use will be progressively more efficient and based on clean and renewable energy sources, such as solar, wind, and waterpowers. However, the issue of climate change caused by greenhouse gas emissions from the usage of fossil fuels is one of the significant challenges that need to be addressed in the effort towards more sustainable energy consumption [2]. Climate change threatens the human living environment, such as increased global average temperatures, sea level rise, unstable rainfall patterns, and extreme weather events [3].

As stated by [4] Climate change's threat will become evident on its own. The development sector may complicate the characteristics of energy performance, then the accounting procedures are inadequate in accommodating the credit market, further, the expansion of CO₂

from humans and fossil fuels [5] [6], climate factors that endanger food production and sea level rise and will result in flood risks [3].

One of the tools for carbon pricing is the carbon tax [4] and is used to deal with global warming and climate change [3] where there is a carbon economic value for comprehensive policies to mitigate climate change and Cut back on the usage of fossil fuels, which harm the environment and contribute to global warming. [3], There are two types of instruments of carbon economic value, namely the emission trading system and emission offsets this policy aims to expect changes in stakeholder behavior [6] and economic actors to be concerned and have a view of low carbon green economy activities, followed by a carbon tax to support the target of long-term reduction of greenhouse gas emissions.

Moreover, with the countless activities of business actors in emitting carbon, the existence of a carbon tax may encourage innovation [7], the latest and environmentally conscious technology [3], economic technology analysis, [8], blockchain technology [4], technological and process innovation [9] and more efficient to environmentally friendly investments, (Nerisha et al., n.d.). Finally, the purpose of a carbon tax is equitable, affordable, and gradual, meaning that the existence of justice will be able to fulfill the polluter pays principle, paying attention to the affordability aspect for the benefit of society.

The main issue why the carbon tax was introduced was the negative externality impact caused by the activities of the products produced by businesses. However, according to, a carbon tax can minimize the impact of negative externalities [5], a carbon tax can minimize the impact of negative externalities [3]. One of them is the risk of climate change, for instance, the possibility of increased flooding and drought will exacerbate the scarcity of clean water. In addition, damage to land ecosystems by forest fires, eliminating biodiversity (Vimal & Rajak, 2022). Not only terrestrial ecosystems, but climate change also leading to damage to marine ecosystems, rising sea surface temperatures will result in the extinction of coral reefs, seaweed, mangroves, and other marine ecosystems. Further deterioration of health, food scarcity.

According to the World Bank in 2021, carbon pricing advanced from the previous year. It is anticipated to be a useful source of funding to assist in a long-term, sustainable economic recovery, which can fund more extensive budgetary reforms for countries that have an impact on the future of the carbon transition. However, carbon taxes are considered an effective political tool for the prevention of externality impacts [3]. Besides, carbon taxes are considered to be distributed unequally and may burden groups with lower incomes [10], [11] state that carbon pricing is detrimental if the pricing is regressive.

The report outlines recent developments in carbon pricing worldwide, 68 direct carbon pricing mechanisms are available as of right now, 36 carbon taxes, and 32 emissions trading schemes (ETS) (Vimal & Rajak, 2022). Since the release of the 2021 carbon pricing status and trends report, the four new carbon pricing tools have been put into practice one in Uruguay and three in North America (Ontario, Oregon, New Brunswick) [7]. Countries that informed plans for new carbon pricing policies include Israel, Malaysia's carbon emissions are estimated to be reduced by 40% [5] dan Botswana.

For South Africa, although new carbon tax regulations in the country are feared to have an impact on disparities and inequalities in income distribution [12]. Carbon prices have reached record highs in many jurisdictions, including the European Union, California, New Zealand, South Korea, Switzerland, and Canada. According to the analysis, however, direct carbon prices currently cover less than 4% of global emissions, falling short of what will be required by 2030 to reach the temperature targets set forth in the Paris Agreement. Meanwhile, according to [3] the way to determine the carbon price is the elimination of fossil fuels and the implementation of regulations involving social carbon costs and fuel taxes.

This study aims to seek the trends, the effect of greenhouse gas emissions from emission sources, with carbon tax revenues can be used for addition and development, adaptation and mitigation of climate change, environmentally friendly investment, support for low-income people in the form of social assistance. While according to (Vimal & Rajak, 2022), Carbon Tax can be reduced by limiting the excessive use of natural resources and energy, so that it will have an impact on reducing the waste generated due to the process after the product life [13], [10]. Derived from the background and objectives of the study, the following research question will be raised.

1. What is the current study on carbon taxes publishing trend
2. Which publications on carbon pricing studies have the greatest impact
3. What identifying opportunities for future research
4. What topics in carbon tax research and cluster have received the greatest attention in the literature?

2 Literature Review

According to [5] the existence of a carbon tax minimizes the negative impact of externalities stemming from climate change, promotes the use of ecologically friendly products and technology, and a decrease in the amount of energy consumption, in addition to the primary purpose of the carbon tax is to reduce greenhouse gasses. [5] elaborate that carbon emissions can be diminished and used more effectively if there is cooperation between all industrial sectors in dealing with climate change and reducing emissions. Additionally, there must be an agreement in the adoption of green technology to avoid massive carbon taxes.

While other carbon emission reductions with strategies by determining the location of the factory and demand must be known in advance [6] must be aware of the limit of factory capacity, the number of companies that are mutually involved, the implication is that there is a network integration of several sustainability concepts in the strategy implemented [14].). The usage of by-products with no additional cost to the industry [15].

There are copious opinions about the threats and opportunities of carbon tax, it has been discussed the chances if carbon tax is executed, but it should be noted that there are many threats if carbon tax is implemented, such as businesses will be arbitrary in using energy in any way (Gamze ,yildiz, seren, 2020). The worst part is that a carbon tax may lead to tax evasion by exporting pollution to low-income countries. Carbon taxes also broaden inequality [10].

The threat is likely to be different in every country around the world. According to [7] developed countries have carbon taxes that are regressive, and do not apply in developing countries. The research findings revealed that there is a diverse impact of carbon tax distribution. With the threat posed by carbon taxes, some literature solutions to the effects generated to minimize carbon taxes, namely the combination of energy and technological innovation [16]

Furthermore, literature that examines the economic impact of economic activities of policies adopted despite climate change is very vulnerable [13], while literature that states the feasibility of carbon taxes in the country of Ukraine is significantly reliant on the political will in general and the power of the negotiating group [17]. Unlike literature [11] for the country of Hawaii with a source of income derived from tourism, they produce their own electricity, Hawaii's cumulative emissions decrease, so that it allows to overcome the global climate crisis.

2.1 Bibliometric Analysis

Bibliometric analysis is a document measurement tool, including journal articles, conference proceedings, books, and others. The purpose of bibliometric analysis is initially mapping the state of the art of literature, which can be used with datasets from several sources such as Scopus and Web of Science. The second step was to assess the growth and trend of research, meaning that the development of studies can be examined from publications from the year, author, institution. The next step, bibliometric analysis, can illustrate the history and evolution of research over time. The last step is distinguishing citations and impact, metrics of total citations can be used to gauge the influence of articles, then can visualize and map scientific research networks, identify research gaps.

3 Methods

The research purpose is to examine productivity and trends in the global perspective on carbon tax using bibliometric analysis [18]. Some indicators of bibliometric analysis, such as network visualization, are presented in this study. Research methods related to bibliometric analysis for Carbon Tax topics involve collecting data from relevant bibliographic sources and analyzing existing publications to identify trends, patterns, and author contributions in the field.

In this study, the research question formulation used the PICO Framework (Population, intervention, comparison and outcome), although the Pico Framework has several weaknesses, namely the Pico Framework tends to focus on the internal elements of the research question (population, intervention, comparison, and results), and can ignore external context factors are relevant in SLR, but the pico framework helps researchers to identify important elements in research questions, namely population, intervention, comparison, and outcome. With a clear focus, SLR can be more focused and systematic, formulating keywords and search parameters that are more specific. This helps optimize search results and ensures the relevance of articles included in reviews, helps reduce bias in the review process, because clear and focused research questions can avoid selecting articles that are irrelevant or not in accordance with the research objectives [19], [20]

Identification and selection of suitable databases to collect Carbon Tax related publications Tax [21]. Some databases that are frequently used in this research are Scopus. Subsequently, creating a list of keywords relevant to carbon tax, such as "carbon tax," "carbon pricing," "carbon emissions," and so on. These keywords will be utilized in the database search to identify relevant publications. Next, conduct a search by the predefined keywords in the selected database. Collecting publications that match the topic of Carbon Tax, including journal articles, books, conferences, reports, and others [22]. Besides, reviewed and screened the publications based on the inclusion and exclusion criteria set earlier. This included checking abstracts, titles, and keywords to ensure relevance to the research topic.

The following step was to collect relevant bibliographic data from the selected publications. This included information such as title, year of publication, author, journal, number of citations. analyze the data that has been collected using bibliometric methods [23]. Numerous of the commonly used methods in bibliometric analysis include author productivity analysis, citation analysis, journal analysis, and visualization of collaboration networks between au-

thors. Finally, interpreted the results of the analysis to identify trends, patterns, and author contributions in Carbon Tax topics [22].

3.1 Search Strategy and Data Analysis

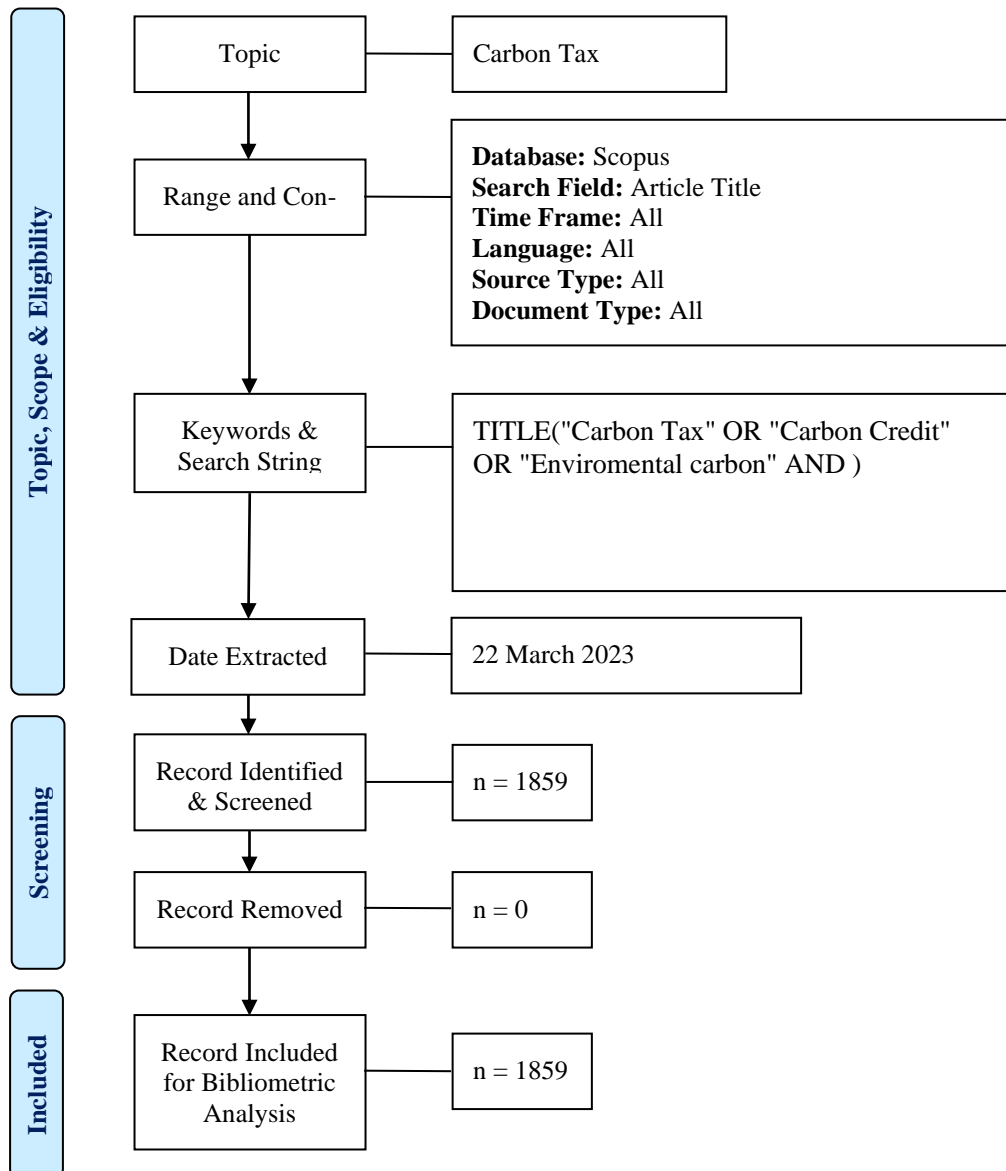


Figure 1. The Search Strategy's Flow Diagram
Source: Zakaria et al. (2020), Moher et al. (2009)

4 Results

4.1 Documents Profiles

Total publications with documents as much as 1498 or 80.58% are document types in the form of articles, and 157 or 8.45% of the total publications are in the form of book chapters and followed by conference papers with a total publication of 90 or 4.84%. The author's interest in discussing carbon tax is to use articles rather than book chapters, or conference papers, reviews, notes, books, or editorials.

Table 1. Document Type

Total Documents		1859
Document Type	Total Publication	Percentage
Article	1498	80.58%
Book Chapter	157	8.45%
Conference Paper	90	4.84%
Review	51	2.74%
Note	21	1.13%
Book	17	0.91%
Editorial	9	0.48%
Short Survey	8	0.43%
Retracted	3	0.16%
Conference Review	2	0.11%
Erratum	2	0.11%
Business Article	1	0.05%

In bibliometric analysis, Source type refers to the types of publication or source being analyzed. Meanwhile, in table 2, document source types can be classified into five different source types, Journals are the source types that are displayed highest with 1541 documents (82.89%). A large percentage of journals is due to articles published in scientific journals. Journal articles are often considered as the primary source in bibliometric analysis because they represent research conducted by academics and scientists, followed by books (146) with a percentage rate of 7.85% of the total publications. Finally, followed by conference proceedings (71), trade journal (69), book series (32).

Table 2. Source Type

Source Type	Total Publications	Percentage
Journal	1541	82.89%
Book	146	7.85%
Conference Proceeding	71	3.82%
Trade Journal	69	3.71%
Book Series	32	1.72%

4.2 Language of Document

In table 3. With 97.69% of all publications from 1819, English is the language most frequently used. Then followed by several languages that are also used in publishing articles, namely Russian, French, Spanish, Portuguese, German, Chinese, Italian.

Table 3. Languages

Language	Total Publication	Percentage
English	1819	97.69%
Russian	13	0.70%
French	10	0.54%
Spanish	9	0.48%
Portuguese	5	0.27%
German	3	0.16%
Chinese	2	0.11%
Italian	1	0.05%

4.3 Subject Area

Carbon tax serves to minimize the risk of climate change, and research related to carbon tax is mostly published in Business, Management and, Accounting and Economics, Econometrics and Finance. This is evidenced in Table 4 that the highest subject areas are Economics, Econometrics and Finance with 1310 or 70.47% and Business, Management, and Accounting with 822 or 44.22% of the total publications, followed by Energy, Engineering, Environmental Science, Social Sciences, Decision Sciences. Environmental Science with a total publication of 690 with a percentage level of 37.12%, Energy with a total publication of 487 (26.20%), Engineering with a total publication of 326 (17.54%).

Table 4. Subject Area

Subject Area	Total Publication	Percentage
Agricultural, and Biological Sciences	82	4.41%
Arts and, Humanities	16	0.86%
Biochemistry, Genetics and Molecular Biology	3	0.16%
Business, Management, and Accounting	822	44.22%
Chemical, Engineering	2	0.11%
Chemistry,	1	0.05%
Computer, Science	54	2.90%
Decision, Sciences	143	7.69%
Earth, and Planetary Sciences	2	0.11%
Economics, , Econometrics and Finance	1310	70.47%
Energy,	487	26.20%
Engineering,	326	17.54%
Environmental, Science	690	37.12%

Materials Science	10	0.54%
Mathematics	40	2.15%
Medicine	2	0.11%
Multidisciplinary	1	0.05%
Psychology	14	0.75%
Social Sciences	322	17.32%

4.4 Publication Trends

The publication trend in the last ten years from 2013 to 2022 can be seen that publications on carbon tax from year to year fluctuate, in 2013 (84), 2014 (120), 2015 (117), 2016 (111), 2017 (136), 2018 (117), 2019 (98), 2020 (87), 2021 (90), 2022 (106). In this table, the highest total publication is the publication in 2017 of 136 publications with a percentage level of 12.76% and a total publications citation of 98, in contrast to the publication in 2018 even though the total published was 117 with a percentage level of 10.98% but the total citations was 102, it can be inferred that even though the total publications per year are many, it will not follow the number of citations as well.

Table 5. Year of Publication

Row Labels	TP	%	Cumm. TP	Cumm. %	NCP	TC	C/P	C/CP	h-index	g-index
2013	84	7.88%	84	7.88%	76	2304	27.43	30.32	26	46
2014	120	11.26%	204	19.14%	95	2654	22.12	27.94	26	49
2015	117	10.98%	321	30.11%	94	2432	20.79	25.87	26	47
2016	111	10.41%	432	40.53%	90	1537	13.85	17.08	19	36
2017	136	12.76%	568	53.28%	98	2049	15.07	20.91	23	42
2018	117	10.98%	685	64.26%	102	1618	13.83	15.86	25	34
2019	98	9.19%	783	73.45%	76	901	9.19	11.86	17	24
2020	87	8.16%	870	81.61%	70	788	9.06	11.26	16	24
2021	90	8.44%	960	90.06%	56	436	4.84	7.79	11	17
2022	106	9.94%	1066	100.00%	51	137	1.29	2.69	5	7
Grand Total	1066	100.00%			808	14856	13.94	18.39	194	326

Table 6 shows that there are 525 documents written by a single author, followed by 772 of documents written by two authors.

Table 6. Author(s) Listed for Each Document

Row Labels	Total Publication	Percentage
0	20	0.90%
1	525	23.71%
2	771	34.82%
3	554	25.02%
4	211	9.53%
5	87	3.93%
6	19	0.86%
7	14	0.63%

8	7	0.32%
9	1	0.05%
10	2	0.09%
12	1	0.05%
15	1	0.05%
16	1	0.05%
Total	2214	100.00%

4.5 Publications by Institutions

International,Journal of Productivity and Performance Management,United Kingdom Emerald Publishing, International Journal of Operations and Production,Management United Kingdom Emerald Publishing, Measuring Business Excellence United Kingdom Emerald Publishing, International Journal of Business Performance Management United Kingdom Inderscience Enterprises, Production Planning and Control United,Kingdom Taylor and Francis, International,Journal of Production Research United Kingdom,Taylor and Francis, Management Accounting Research United States Academic Press , Public Money and Management United Kingdom Taylor and Francis

Table 7. Most Productive Institutions With Minimum of Five Publications

Row Labels	TP	NCP	TC	C/P	C/CP	h-index	g-index
International,Journal of Productivity and Performance Management	115	107	3518	30.59	32.88	35	55
International Journal of Operations and Production Management	75	73	10248	136.64	140.38	43	75
Measuring Business Excellence	62	57	1634	26.35	28.67	24	39
International Journal of Business Performance Management	47	44	828	17.62	18.82	14	27
Production Planning and Control	39	35	1473	37.77	42.09	23	38
International Journal of Production Research	39	38	2366	60.67	62.26	25	39
Management Accounting Research	35	34	3566	101.89	104.88	27	35
Public Money and Management	35	35	835	23.86	23.86	15	28
International Journal of Production Economics	35	35	4544	129.83	129.83	27	35
Total Quality Management and Business Excellence	24	22	411	17.13	18.68	14	20
Benchmarking	23	22	1828	79.48	83.09	14	23
Management Decision	21	21	912	43.43	43.43	14	21
Studies in Managerial and Financial Account-	21	15	56	2.67	3.73	4	6

ing							
Accounting, Organizations and Society	20	19	3332	166.60	175.37	17	20
Public Performance and Management Review	19	19	298	15.68	15.68	11	17
Financial Accountability and Management	17	16	611	35.94	38.19	13	17
Advances in Management Accounting	16	14	81	5.06	5.79	5	8
Decision Management: Concepts, Methodologies, Tools, and Applications	15	1	1	0.07	1.00	1	1
Business Process Management Journal	15	15	626	41.73	41.73	11	15

4.6 Publications by Countries

Table 8 showed that the country that has conducted the most research on carbon tax is the United States, with 526 of the total publications or 28.29%, followed by China with 318 of total publications with a percentage level of 17.11%. China, as the country with the largest population in the world and one of the largest energy users, is experiencing serious problems related to air pollution and poor air quality [24]. The Chinese government also recognizes that the country requires transition to a more sustainable economy [25], by reducing dependence on fossil fuels and increasing the use of clean energy. Carbon tax can be one of the policy instruments to accelerate such transition and reduce greenhouse gas emissions in China.

Table 8. Top 20 Countries Contributed to the Publications

Country	Total Publikasi	Persentase (%)
United States	526	28.29%
China	318	17.11%
United Kingdom	176	9.47%
Australia	127	6.83%
Canada	121	6.51%
Germany	111	5.97%
Netherlands	104	5.59%
India	102	5.49%
France	95	5.11%
Japan	63	3.39%
Italy	60	3.23%
Switzerland	60	3.23%
Norway	56	3.01%
Sweden	37	1.99%
Brazil	36	1.94%
Austria	31	1.67%
Russian Federation	31	1.67%
South Korea	28	1.51%
Spain	28	1.51%
Taiwan	22	1.18%

South Africa	19	1.02%
Iran	16	0.86%
Ireland	15	0.81%
Turkey	15	0.81%
Pakistan	14	0.75%
Thailand	14	0.75%
Belgium	13	0.70%

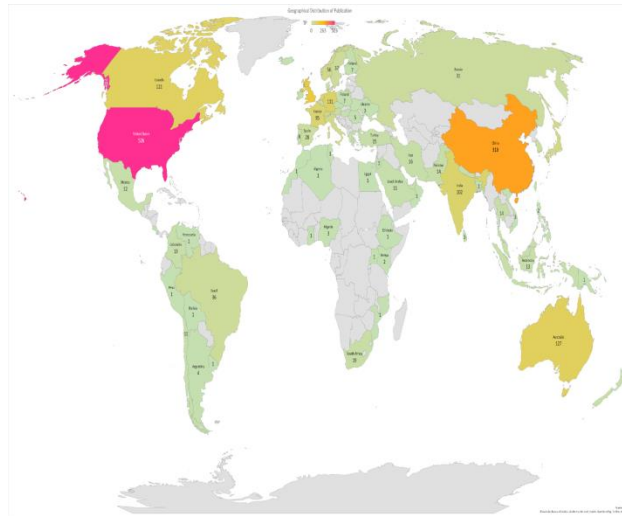


Figure 2. Worldwide Scientific Production Indexed by Scopus on Labour Relations

4.6.1 Co-authorship by Countries

On the other hand, One of the biggest producers of greenhouse gases worldwide is the United States. and has a major impact on climate change. The United States government has also noticed that many other countries are implementing carbon taxes and utilizing more sustainable energy, so it refuses to be left behind in terms of clean technology innovation and development. A carbon tax could assist in creating incentives to boost energy efficiency and clean energy use in the United States.

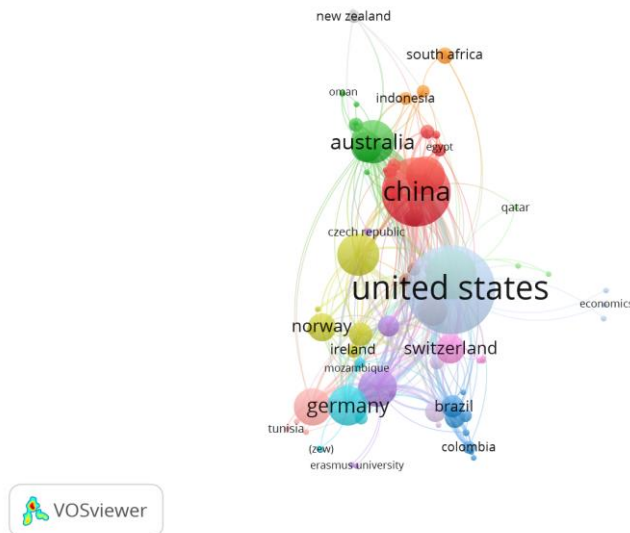


Figure 3. Co-Authorship by Country on a Network Visualisation Map

4.7 Titles of Publications from Sources

The "Most Active Source Titles" analysis assists in identifying journals, conferences, or other publications that are the primary venues for research publications in the field under study [26]. It allows researchers to figure out where their research will receive maximum exposure or where they can seek current and relevant research. It allows the researchers to identify and understand the most active and influential publication sources in the research field [27]. This information is beneficial to target publication selection, finding current research, and understanding trends and dynamics.

Table 9 shows the total publication of the Journal of Cleaner Production, as many as 202 or 10.87% of publications, published by Elsevier Ltd, then Energy Economics with a total of publications of 129 or 6.94%, the total publication of the Journal, of Environmental Economics And Management as many as 64 articles and published by Academic Press Inc, Environmental And Resource Economics with a total publication of 61 with a percentage level of 3.28%. Of the 15 primary places of research publications in the field under study there are eight source titles hosted by Elsevier Ltd, meaning that Elsevier Ltd is the most active and influential publication source in the research field.

Table 9. Titles of the Most Active Sources

Source Title	TP	%	Publisher	Cite Score	SJR 2020	SNIP 2020
Journal,Of Cleaner Pro- duction	202	10.87%	Elsevier ltd			
Energy Economics	129	6.94%	Elsevier ltd			
Journal Of Environmen- tal,Economics And Man- agement	64	3.44%	Academic Press Inc			
Environmental And,Resource Economics	61	3.28%	Springer Neth- erland			
Ecological,Economics	56	3.01%	Elsevier ltd International Association for Energy Econom- ics			
Energy Journal	42	2.26%				
Resource And Energy Economics	35	1.88%	Elsevier ltd World Scientific Publishing Co. Pte Ltd			
Climate Change Econom- ics	34	1.83%				
Forest Policy And Eco- nomics	28	1.51%	Elsevier ltd			
Resources,Conservation And Recycling	28	1.51%	Elsevier ltd			
International Journal Of Production,Economics Environment	26	1.40%	Elsevier ltd			
,Development And Sus- tainability	25	1.34%	Springer Neth- erland			
Environmental Economics And,Policy Studies	18	0.97%	Springer Japan			
Journal Of Public Eco- nomics	18	0.97%	Elsevier ltd			
Frontiers In Energy Re- search	14	0.75%	Frontiers Media S.A.			

4.8 Citation Metrics

The purpose of applying citation metrics in bibliometric analysis is to measure and evaluate the influence and impact of scientific publications or research [23]. Citation metrics are employed to measure the extent to which scientific publications or research has influenced academic literature and a particular research field. By looking at the number and pattern of citations received by a publication, the researchers can gain an understanding of the extent to which the research is a reference for future studies and is essential to the advancement of science [22]. Table 10 revealed that from 1859 total publications related to carbon tax, and there are 43,453 citations obtained, with 1316 citations per year.

Table 10. Metrics for citations

Source	Data
Papers,	1859
Citations,	43453
Years,	33
Cites,Year	1316.76
Cites,Paper	23.37
Cites,Author	20726.45
Papers_Author	930.95
Authors,Paper	2.62
h,index	94
g,index	148

4.9 Highly Cited Documents

Analysis of Highly Cited Documents can help in understanding essential research trends and focus in a particular field. Identifying highly cited documents can provide insights into research topics that are in the limelight and indicate the direction in which research is progressing [26],) and help recognize research that has made significant contributions in a particular field of research. These documents often reflect important thoughts, findings or concepts that have influenced scientific development and direction [26]

Meanwhile, Table 11 when viewed from the top five highly cited articles the first is D. Acemoglu, P. Aghion, L. Bursztyn, D. Hemous (2012) with the title: The environment and directed technical change (National bureau of economic research) with a total of 1112 publications with an average annual citation of 101.09, the second is W.D. Nordhaus (2008) with the title: A question of balance weighing the options on global warming policies (Yale University Press) with a total publication of 951 with an average annual citation of 63.4, then followed by the third is H.-W. Sinn (2008) with the title: Public policies against global warming: A supply side approach (International Tax Public Finance) with a total publication of 538, average annual citations of 35.87, the fourth is C.L. Weber, H.S. Matthews (2008) with the title Quantifying the global and distributional aspects of American household carbon footprint (Ecological economics) with a total publication of 395, average annual citations of 26.33. The last is J. Paavola, W.N. Adger (2006) Fair adaptation to climate change (Ecological economics) with a total publication of 374, the average annual citation of 22.

Table 11. Top 20 Highly Cited Articles

No.	Author(s)	Title	TC	C/Y
1	D. Acemoglu, P. Aghion, L. Bursztyn, D. Hemous (2012)	The environment, and directed technical change	1112	101.09
2	W.D. Nordhaus (2008)	A question of balance, weighing the options on global warming policies	951	63.4
3	H.-W. Sinn (2008)	Public policies, against global warming: A supply side approach	538	35.87
4	C.L. Weber, H.S. Matthews (2008)	Quantifying, the global and distributional aspects of American household carbon footprint	395	26.33
5	J. Paavola, W.N. Adger (2006)	Fair, adaptation to climate change	374	22

6	P. Aghion, A. Dechezleprêtre, D. Hémous, R. Martin, J. van Reenen (2016)	Carbon taxes, path dependency, and directed technical change: Evidence from the auto industry	348	49.71
7	L.H. Goulder, S.H. Schneider (1999)	Induced technological change and the attractiveness of CO2 abatement policies	334	13.92
8	G.C. van Kooten, C.S. Binkley, G. Delcourt (1995)	Effect of carbon taxes and subsidies on optimal forest rotation age and supply of carbon services	333	11.89
9	L.H. Goulder, K. Mathai (2000)	Optimal CO2 abatement in the presence of induced technological change	332	14.43
10	M. Golosov, J. Hassler, P. Krusell, A. Tsyvinski (2014)	Optimal Taxes on Fossil Fuel in General Equilibrium	318	35.33
11	D. Scott, P. Peeters, S. Gössling (2010)	Can tourism deliver its "aspirational" greenhouse gas emission reduction targets?	314	24.15
12	S. Becken (2007)	Tourists' perception of international air travel's impact on the global climate and potential climate change policies	290	18.13
13	D. Popp (2004)	ENTICE: Endogenous technological change in the DICE model of global warming	285	15
14	W.D. Nordhaus (1993)	Rolling the 'DICE': an optimal transition path for controlling greenhouse gases	277	9.23
15	D. Acemoglu, U. Akcigit, D. Hanley, W. Kerr (2016)	Transition to clean technology	273	39
16	M. Hoel, S. Kverndokk (1996)	Depletion of fossil fuels and the impacts of global warming	267	9.89
17	A. Baranzini, J. Goldemberg, S. Speck (2000)	A future for carbon taxes	249	10.83
18	A. Zakeri, F. Dehghanian, B. Fahimnia, J. Sarkis (2015)	Carbon pricing versus emissions trading: A supply chain planning perspective	239	29.88
19	I.W.H. Parry, R.C. Williams III, L.H. Goulder (1999)	When can carbon abatement policies increase welfare? The fundamental role of distorted factor markets	233	9.71
20	H. Yang, W. Chen (2018)	Retailer-driven carbon emission abatement with consumer environmental awareness and carbon tax: Revenue-sharing versus Cost-sharing	222	44.4

4.10 Top Keywords

Analyzing the "Top Author's Keywords" can identify the topics or sub-fields most frequently discussed by authors in the literature [23]. It helps in understanding the research trends, main focus, and area of expertise of a particular author or group of researchers. In Table 12, research trends and main focus of 1859 total publications, which there are 545 studies related to carbon tax followed by emission control 417, carbon 397 publications,

carbon taxes 338 publications, pollution taxes 329 publications, Climate Change 310 publications, Taxation 289 publications, Carbon Emission 223 publications, Environmental Economics 221 publications, Carbon Dioxide 204 publications.

Therefore, through analyzing "Top Author's Keywords" over time, we can observe changing trends and developments in research topics. This provides insight into how research is evolving, what topics are emerging, and how researchers' interests change over time.

Table 12. Top Author's Keywords

Keywords	Total Publication	Percentage
Carbon Tax	545	29.32%
Emission Control	417	22.43%
Carbon	397	21.36%
Carbon Taxes	338	18.18%
Pollution Tax	329	17.70%
Climate Change	310	16.68%
Taxation	289	15.55%
Carbon Emission	223	12.00%
Environmental Economics	221	11.89%
Carbon Dioxide	204	10.97%
Costs	201	10.81%
Environmental Policy	184	9.90%
Carbon Emissions	156	8.39%
Commerce	134	7.21%
Greenhouse Gases	133	7.15%
Climate Policy	132	7.10%
Economics	112	6.02%
Global Warming	112	6.02%
Gas Emissions	106	5.70%

4.11 Co-Occurrence Analysis

Co-occurrence analysis enables the identification of topics and subfields that are most frequently discussed in scientific literature. By looking at the co-occurring terms, it is helpful in mapping the existing knowledge network in the research field [26]. Figure 3 shows that carbon tax, carbon emission and greenhouse gas co-occur in a large pattern. Subsequently, the results visualize the relationship between different concepts and illustrate the knowledge structure. Information from term co-occurrence analysis can be used to improve literature findings [26]. By paying attention to terms that frequently appear alongside search keywords, we can expand the range of searches and ensure that the literature is relevant. This figure shows several clusters that connect related keywords.

The analysis of Overlay a phrase co-occurrence network's visual representation based on Author keywords makes it possible to see the relationship between different concepts and understand how they are interrelated in the research field [26]. Through overlay visualization of term co-occurrence networks over time, it can observe trends and developments in the research field. This helps in understanding how concepts and the linkages between them change over time.

Figure 3 depicted that the clusters are separated and classified into renewal years. The first is 2010 indicated by purple clusters, where the keywords used in that year are global

warming, environmental economy, energy, climate, then in 2012-2014, the keywords used are carbon tax, carbon policy, climate change, climate policy, renewable energy, greenhouse, energy efficiency, and carbon price. It was in this year that the trend of carbon tax began to be much in the spotlight because many environmental impacts appeared. In 2018-2020, marked by the green cluster, the keywords for carbon tax development are social cost carbon, welfare, renewable, integrated assessment, emission, environmental uncertainty, environmental innovation, environmental tax, carbon pricing and emission reduction.

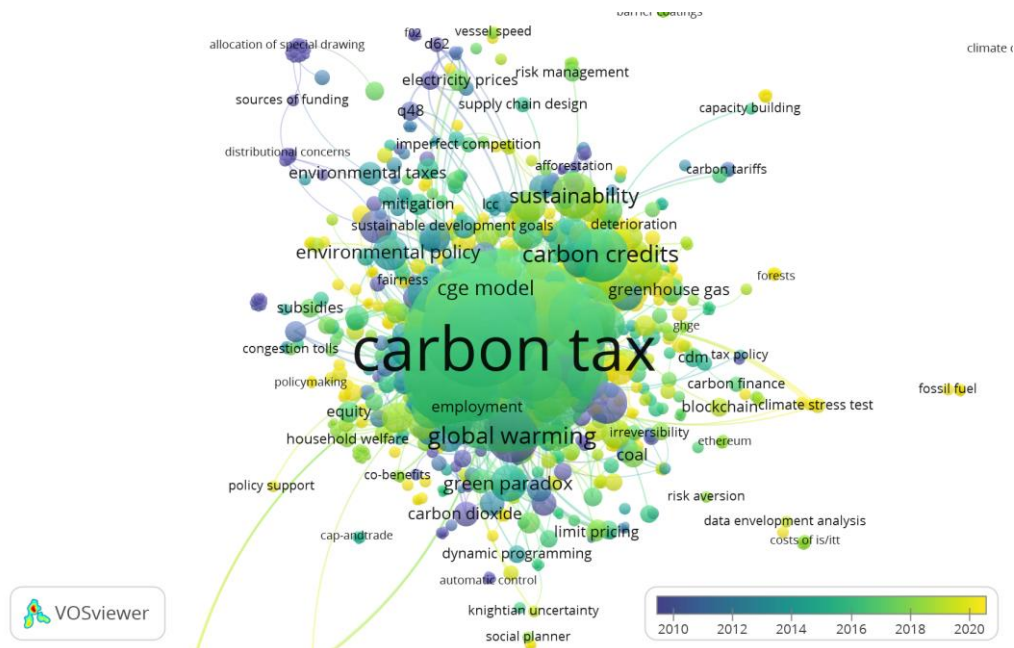


Figure 3. An Overlay Visualization of a Keyword-Based Phrase Co-Occurrence Network

4.12 Citation Analysis

4.12.1 Analysis of Citations by Documents

It allows the researchers to identify and understand the citation network between scientific documents. It visualizes how documents are interconnected through citations and reveals the patterns of relationships that exist, thus helping in mapping the influence and impact of a particular document in scientific literature [26]. Documents that receive copious citations or play a central role in the citation network can be identified. Nonetheless, with this analysis, the citation map network visualization helps in understanding the relationship between researchers through citations in the scientific literature. By scrutinizing documents that are cited simultaneously by different researchers, the researchers can identify collaborations, research networks, or scientific communities that exist within a particular field.

From Figure 4, the cluster clusters are divided into color parts from 2000 to 2020, and from the color differences, we can analyze the relationship between the color clusters.

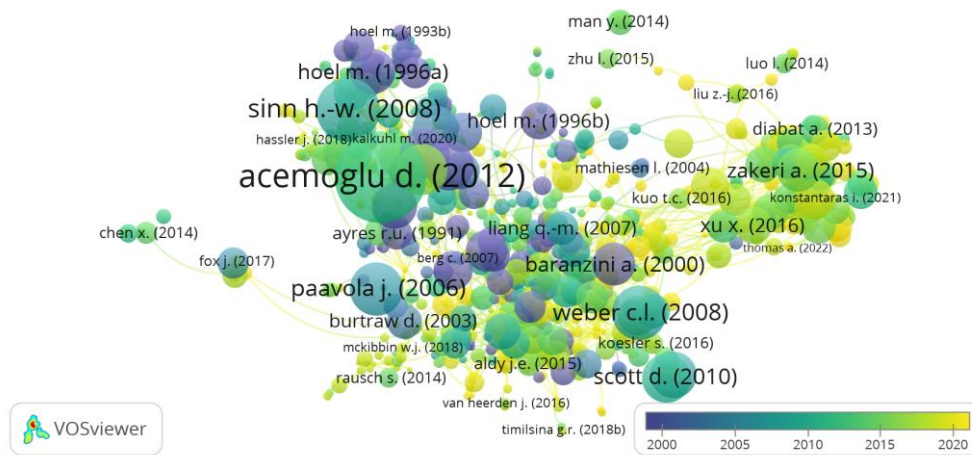


Figure 4. Map Visualizing Networks of the Citation by Documents

5 Discussion

Top Author's Keywords can ascertain the topics or sub-fields most frequently discussed by authors in the literature [23]. This helps in understanding the research trends, main focus, and area of expertise of a particular author or group of researchers. In Table 12, research trends and main focus of 1859 total publications, there are 545 studies related to carbon tax, followed by emission control with 417 publications, carbon with 397 publications, carbon taxes with 338 publications, pollution taxes with 329 publications, Climate Change with 310 publications, Taxation with 289 publications, Carbon Emission with 223 publications, Environmental Economics with 221 publications, Carbon Dioxide with 204 publications. Therefore, through the analysis of "Top Author's Keywords" over time, it can observe changing trends and developments in the research topic. It provides insight into how research is evolving.

There are 20 top highly cited articles, namely Acemoglu, P. Aghion, L. Bursztyn, D. Hémous (2012) with the title: The environment and directed technical change (National bureau of economic research) The second is W.D. Nordhaus (2008), with a total of 1112 articles and an average yearly citation of 101.09, titled "A question of balance weighing the options on global warming policies." (Yale University Press) with a total publication of 951 with an average annual citation of 63.4, then followed by the third is H.-W. Sinn (2008) under the heading: Supply-side strategies for public policy aimed at curbing global warming (International Tax Public Finance) with a total publication of 538, the average annual citation is 35.87.

The Chinese government also recognizes that the nation must make the shift to a more sustainable economic model. [28], by using more sustainable energy sources and decreasing reliance on fossil fuels. One of the tools for policy can be a carbon tax to accelerate this transition and reduce greenhouse gas emissions in China. Meanwhile, the The United States is among the top emitters of greenhouse gases globally. and has a crucial impact on climate change. The United States government has also noticed that many other countries are implementing carbon taxes and growing the amount of renewable energy used, so it refuses to be

left behind in terms of clean technology innovation and development. A carbon tax can help create incentives to increase energy efficiency and clean energy use in the United States.

The widespread attention given to these areas demonstrates their importance in addressing climate change, environmental sustainability, and economic policies related to reducing carbon emissions. The prominence of carbon tax research shows a strong interest in understanding and evaluating the effectiveness, efficiency, and implications of carbon taxation as a policy instrument for climate change mitigation. Researchers can explore various aspects, such as the design and implementation of carbon tax systems, their impact on carbon emissions, economic consequences, political feasibility, and interactions with other policy measures.

The attention given to clusters in carbon tax research suggests a focus on identifying and analyzing groups or clusters of related topics within the broader field. These clusters may represent specific subtopics, areas of expertise, or emerging research trends in carbon tax research. The study of clusters helps researchers and policymakers gain a comprehensive understanding of the multidimensional aspects of carbon taxation and its relationship with other disciplines, such as economics, environmental science, public policy, and international relations.

5.1 Contribution of the Study

As countries involved in research on carbon tax, China, and the United States (US) have made significant contributions in understanding and developing the concept. Here are some contributions they can make: Analytical Research: China and the US have research institutes focus on energy and environmental policy analysis. They can conduct analytical research to understand the economic, social, and environmental implications of implementing a Carbon Tax. Such research may offer insights into the potential impact of the policy on the industrial sector, consumers, and greenhouse gas emissions.

Policy Planning China and the US can use their research to design an effective policy plan to implement the Carbon Tax. They determine key sectors that should be targeted, the optimal scale of tax rates, and additional incentive measures to encourage the transition to clean energy. Countries can also contribute to international collaborations with research institutes and other organizations to learn from the experiences of nations that have imposed carbon taxes. This could involve the exchange of knowledge, data, and best practices in order to inform policy and produce more robust research outcomes. Through these research contributions, China and the US can play a necessary role in understanding the effectiveness, potential benefits, and challenges of implementing the Carbon Tax as a policy tool in worldwide efforts to mitigate climate change and reduce greenhouse gas emissions.

While the contribution for Indonesia is that it should be able to increase company awareness of the direct impact of carbon emissions produced by their operations. By understanding the financial consequences of a carbon tax, companies may become more motivated to reduce their emissions and implement sustainable actions, and help companies understand how to present this information in their financial reports and ensure consistency and compliance with applicable regulations. And should be able to assist companies in identifying risks and business opportunities related to sustainability. This information can be the basis for companies to make strategic decisions in directing investment and developing sustainable initiatives

5.2 Future Research Direction

Integration with Other Policies, the carbon tax can be envisioned as one instrument within a broader policy framework. Future research could explore ways to integrate the Carbon Tax with other energy policies, such as incentives for renewable energy, energy efficiency regulations, and emissions trading programs. This study can assist in identifying synergies and trade-offs between different policy instruments and ways to optimize different policy combinations to achieve climate change goals.

Global Implementation, while several countries have implemented carbon taxes, challenges in implementing and coordinating carbon taxes globally remain. Future research could focus on analyzing the impacts and benefits of coordinating Carbon Tax policies among countries and ways to overcome the political, legal, and administrative challenges associated with global implementation. This research can help in designing an effective international framework to address climate change

6 Conclusion

The limitation in this study lies in the uncertainty of the economic impact. Though numerous research on the financial effects of the carbon tax have been conducted, there remains uncertainty in accurately measuring the effect. Research typically employs economic models that rely on certain assumptions, and results may vary depending on the parameters and assumptions used. In addition, the long-term impact of carbon taxes on technological inventiveness and financial dynamics is not well understood. A further limitation is that the effect of carbon taxes on consumer and firm behavior cannot always be predicted with precision. Responses to shifts in energy prices and economic incentives can vary significantly between individuals, industry sectors and regions. Factors such as consumer preferences, access to renewable technologies, and the level of availability of energy alternatives can influence the response to a carbon tax.

Carbon tax implementation recurrently involves complex political factors that change over time. The changes in government, industry interests, and public opinion can influence the sustainability and effectiveness of carbon tax policies. Studies have frequently ignored these political factors and focused on technical and economic analysis, which lead to a mismatch between research results and actual policy implementation. Carbon taxes have significant distributional impacts, especially on economically vulnerable groups. Carbon tax studies tend to pay little attention to distributional implications and the effect on disparities in society and economy. It is important to consider fair remedies and protections for more vulnerable groups in the design of carbon tax policies

References

- [1] T. Dietz and E. A. Rosa, "Rethinking the environmental impacts of population," *Human Ecology Review*, vol. 1, no. 2, pp. 277–300, 1994, [Online]. Available: <https://www.jstor.org/stable/24706840>
- [2] D. Ding, B. Liu, and M. Chang, "Carbon Emissions and TCFD-Aligned Climate-Related Information Disclosures," *SSRN Electronic Journal*, 2022, doi: 10.2139/ssrn.4098231.

- [3] kurular Gamze ,yildiz, seren, "CHAPTER 11 TAX AS A SOLUTION FOR CLIMATE CHANGE," *Emerald publishing*, vol. 104, pp. 165–178, 2020, doi: 10.1108/S1569-375920200000104011.
- [4] J. Woo, R. Fatima, C. J. Kibert, R. E. Newman, Y. Tian, and R. S. Srinivasan, "Applying block-chain technology for building energy performance measurement, reporting, and verification (MRV) and the carbon credit market: A review of the literature," *Build Environ*, vol. 205, no. July, 2021, doi: 10.1016/j.buildenv.2021.108199.
- [5] C. Nerisha *et al.*, "CHAPTER 1 A REVIEW ON CARBON TAX FOR MALAYSIA CONSTRUCTION INDUSTRY," vol. 26, pp. 3–13, doi: 10.1108/S2040-726220220000026001.
- [6] K. E. K. Vimal and S. Rajak, "Investigating the effect of carbon tax on sharing network participation," 2022, doi: 10.1108/JM2-06-2021-0147.
- [7] P. Rathore and S. Bansal, "Distributional Effects of Adopting Carbon Tax in India," *Review of Market Integration*, vol. 5, no. 3, pp. 271–302, 2013, doi: 10.1177/0974929214538348.
- [8] G. Velvizhi, R. Nair, C. Goswami, S. K. Arumugam, N. P. Shetti, and T. M. Aminabhavi, "Carbon credit reduction: A techno-economic analysis of 'drop-in' fuel production," *Environmental Pollution*, vol. 316, no. P1, p. 120507, 2023, doi: 10.1016/j.envpol.2022.120507.
- [9] W. Tsai, C. Yang, C. Huang, and Y. Wu, "The impact of the carbon tax policy on green building strategy," vol. 0568, 2017, doi: 10.1080/09640568.2016.1221800.
- [10] Q. M. Liang, Q. Wang, and Y. M. Wei, "Assessing the Distributional Impacts of Carbon Tax among Households Across Different Income Groups: The Case of China," *Energy and Environment*, vol. 24, no. 7–8, pp. 1323–1346, 2013, doi: 10.1260/0958-305X.24.7-8.1323.
- [11] M. Coffman, P. Bernstein, M. Schjervheim, and S. La Croix, "Economic and GHG impacts of a US state-level carbon tax : the case of Hawai ' i," 2022, doi: 10.1080/14693062.2022.2061405.
- [12] M. Nemavhidi, "Carbon tax as a climate intervention in South Africa : A potential aid or hindrance to human rights ?," vol. 25, no. 1, pp. 11–27, 2023, doi: 10.1177/14614529221149836.
- [13] L. Dwyer, P. Forsyth, R. Spurr, and S. Hoque, "Economic Impacts of a Carbon Tax on the Australian Tourism Industry," *J Travel Res*, vol. 52, no. 2, pp. 143–155, 2013, doi: 10.1177/0047287512461568.
- [14] M. C. Ndukwu *et al.*, "Assessment of eco-thermal sustainability potential of a cluster of low-cost solar dryer designs based on exergetic sustainability indicators and earned carbon credit," *Cleaner Energy Systems*, vol. 3, no. October, p. 100027, 2022, doi: 10.1016/j.cles.2022.100027.
- [15] S. Meng and T. Pham, "The impact of the Australian carbon tax on the tourism industry," *Tourism Economics*, vol. 23, no. 3, pp. 506–522, 2017, doi: 10.5367/te.2015.0514.
- [16] F. Qian, W. Gao, D. Yu, Y. Yang, and Y. Ruan, "Potential analysis of hydrogen energy technology in the power grid based on carbon tax: A case study in Japan," *Energy Exploration and Exploitation*, 2022, doi: 10.1177/01445987221146573.
- [17] M. Frey and M. Frey, "Assessing the impact of a carbon tax in Ukraine Assessing the impact of a carbon tax in Ukraine," vol. 3062, 2017, doi: 10.1080/14693062.2015.1096230.
- [18] S. Edition, A. Ahmi, M. Herry, M. Nasir, and U. Utara, "Examining the Trend of the Research on eXtensible Business Reporting Language (XBRL): A Bibliometric Review," vol. 5, no. 2, 2019.
- [19] S. Cleyle and A. Booth, "Clear and present questions: Formulating questions for evidence based practice," *Library Hi Tech*, vol. 24, no. 3, pp. 355–368, Jul. 2006, doi: 10.1108/07378830610692127.
- [20] C. U. Library, "CRICOS Provider Code 00301J Formulating the question."
- [21] W. Luo, Z. Tian, S. Zhong, Q. Lyu, and M. Deng, "Global Evolution of Research on Sustainable Finance from 2000 to 2021: A Bibliometric Analysis on WoS Database," *Sustainability (Switzerland)*, vol. 14, no. 15, MDPI, 2022, doi: 10.3390/su14159435.
- [22] K. Zhang, Q. Wang, Q. M. Liang, and H. Chen, "A bibliometric analysis of research on carbon tax from 1989 to 2014," *Renewable and Sustainable Energy Reviews*, vol. 58, pp. 297–310, 2016, doi: 10.1016/j.rser.2015.12.089.

- [23] X. Zhou, X. Wei, J. Lin, X. Tian, B. Lev, and S. Wang, "Supply chain management under carbon taxes: A review and bibliometric analysis," *Omega (United Kingdom)*, vol. 98, p. 102295, 2021, doi: 10.1016/j.omega.2020.102295.
- [24] W. Zou and M. Pan, "Does the construction of network infrastructure reduce environmental pollution?—evidence from a quasi-natural experiment in 'Broadband China,'" *Environmental Science and Pollution Research*, vol. 30, no. 1, pp. 242–258, 2023, doi: 10.1007/s11356-022-22159-w.
- [25] M. Perry, "Fisheries Management in Congested Waters: A Game-Theoretic Assessment of the East China Sea," *Environ Resour Econ (Dordr)*, vol. 82, no. 3, pp. 717–740, 2022, doi: 10.1007/s10640-022-00688-9.
- [26] N. Rons, "Bibliometric approximation of a scientific specialty by combining key sources, title words, authors and references," *J Informetr*, vol. 12, no. 1, pp. 113–132, Feb. 2018, doi: 10.1016/J.JOI.2017.12.003.
- [27] D. R. Raban and A. Gordon, "The evolution of data science and big data research: A bibliometric analysis," *Scientometrics*, vol. 122, no. 3, pp. 1563–1581, Mar. 2020, doi: 10.1007/S11192-020-03371-2.
- [28] Y. Cong, C. Zhu, Y. Hou, S. Tian, and X. Cai, "Does ESG investment reduce carbon emissions in China?," *Front Environ Sci*, vol. 10, 2022, doi: 10.3389/fenvs.2022.977049.