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SYSTEMATIC LITERATURE REVIEW: THE DYNAMIC IMPACTS OF CARBON EMISSIONS AND INVESTMENT IN THE G20 FORUM

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Abstract: This study aims to determine the relationship between renewable energy and investment in the G20 forum. With the Kitchenham Systematic Literature Review (SLR) approach using three main data bases, namely Scopus, Spinger, Google Scholar. The final results obtained 11 articles published between 2019 and 2022. Thus this research provides knowledge about the importance of renewable energy and investment that can be used further and its relation to sustainable economic development

Keywords: *Carbon Emissions, G20, Investment*

INTRODUCTION

G20 forum activities are an effort to enhance the image and credibility of a country. By taking an active role, it is hoped that a country can increase its contribution in various fields, such as the economy, trade, politics, health, and various other programs at the G20 forum (Richard., 2022, n.d.)

Of course, the existence of the G20 forum will make it easier for the leaders of member countries to exchange ideas. Regarding the green economy movement, one of them is renewable energy to reduce CO2 emission levels. Where most of the CO2 emissions are generated from agricultural activities (Nansai et al., 2021). Based on these findings, to reduce the greenhouse effect, the G20 forum should not only encourage the development of sustainable agriculture, but also encourage the consumption of renewable energy, especially for developing countries. Therefore, to reduce the effects of global warming, countries in the G20 forum must coordinate tasks in terms of reducing CO2 emissions (Ram et al., 2018).

The agricultural sector is the second largest producer of GHG emissions in the world, accounting for 21% of total global GHG emissions (Habiba et al., 2021). This is due to the use of fossil fuel fertilizers, biomass burning, and agricultural machinery. On the other hand, agriculture can also absorb CO2 through the process of suquestration into soil organic matter (*Liu et a.l, 2017b*, n.d.)

The expansion of economic activity causes an increase in global energy consumption which in turn creates environmental problems, namely global warming. The main cause, of course, is greenhouse gas (GHG) emissions, of which 72% is carbon dioxide (Kumari et al., 2021). Therefore, the issue of CO2 emissions is a crucial issue and must be addressed immediately (Paramati et al., 2017)

Therefore, the application of renewable energy is highly recommended in various sectors, including agriculture. In agriculture, the use of renewable energy will be like this: (a) solar energy can be used for heating, cooling, lighting, product drying, and irrigation of agricultural land, (b) geothermal energy

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can be used to heat land in open fields and drying agricultural produce, (c) wind energy can also be used for heating, cooling, lighting, and water transfer for irrigation, and (d) hydropower can be used for irrigation, electricity production, and drinking water supply. On the other hand, almost all of the G20 countries have increased their consumption of renewable energy or are planning to do so (*Dong et al., 2018a;Ma Dan Cai, 2019;Shuai et al., 2018, 2019*, n.d.).

For developing countries the existence of a policy on implementing renewable energy certainly requires costs. In Indonesia alone it requires investment both from within and outside to support this renewable energy sector, all sorts of preparations are made up to Presidential Regulations and preparing renewable energy development programs (*Direktorat Jenderal EBTKE - Kementerian ESDM*, n.d.)

Considering the background above, then the formulation of the problem will be discussed so that it focuses on the study of literature, results and discussion, namely: (1) The G20 Forum has an effect on reducing CO2 emissions? 2) Does the G20 Forum affect investment? 3) Renewable energy has an effect on investment?

LITERATURE REVIEW

Renewable energy is energy that comes from natural sources that are often consumed, for example, sunlight and wind. There are so many renewable energy sources around us. On the other hand, fossil fuels, gas oil, coal are non-renewable resources and take a long time to form. Non-renewable resources lead to carbon dioxide (CO2), and a dangerous greenhouse gas (Khan et al., 2022).

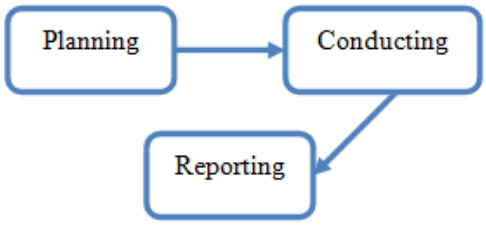
Investment relates to assets or goods acquired with the ultimate goal of getting appreciation or income. Appreciation leads to an increase in asset value over time. Where in this case renewable energy is an investment for a greener and more sustainable country. Sustainability of resources is the key to increasing state revenues. So it is the issue of carbon emissions that is very important to be worked on and resolved(Karkour et al., 2020).

The G20 is the main international economic cooperation forum which plays an important role in terms of forming and strengthening governance in almost all countries which refers to all world economic problems. Founded in 1999 after the financial crisis in Asia, until now the G20 has invited international organizations such as the UN, WB, WHO, IMF, ILO, WTO, OECD and FSB. The G20 Forum is held annually, with a rotating presidency system among its members. Although initially the Forum focused solely on macroeconomic issues, it has now expanded its agenda to include, trade, health, sustainable development, climate change, agriculture, environment, energy and anti-corruption (Xu et al., 2020)

METHOD

This Systematic Literature Review (SLR) research is based on Kitchenham with the following stages (Kitchenham, n.d.):

Figure 1. Step SLR



Starting from determining the main objective of this research, namely, knowing the impact of renewable energy and its relationship to investment in the G20 forum. To determine research questions using the Population,

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Intervention, Comparison, Outcome, and Context (PICOC) Technique:

Table 1. PICOC

Population	G20, renewable energy, investment
Intervention	Renewable energy affects investment
Comparison	-
Outcome	Increased investment due to renewable energy
Context	The impact of renewable energy on investment in the G20

The next stage is to determine the sources of literature review using the following criteria:

No	Author	Year	Previous Research Results	Similarities	Differences
1	Takeshi Kuramochi, Leonardo Nascimento, Mia Moisio, et al	2021	2030 climate targets (Y), greenhouse gas emissions (X)	Greenhouse gas emissions	2030 climate targets
2	Bing Jie Xu, Ruo Yu Zhong, Hui	2020	Analysis of seven G20 countries (Y) on the fuel impact of CO2 consumption (X)	CO2 consumption	Analysis
3	Sefa Aworyi Churchill, Lei Pan, Sudharshan Reddy Paramati	2020	Air Pollution (X1) and Tourism (X2): Evidence from G20 Countries (Y)	G20	Air Pollution, Tourism
4	Xu, Mohammad Musah, Yu Sheng Kong, et al	2020	Heterogeneous analysis of the relationship between energy consumption (X1), economy Growth (X2) and carbon emissions (X3): Evidence from Group of Twenty (G20) countries (Y)	Energy consumption, carbon emissions, G20	Economic growth
5	Yuan Kong, Chao Feng, Liyang Guo	2022	G20 Countries (X1), CO2 Emissions (X2) under Common Socio-Economic Pathway (Y)	CO2 emissions, G20	Social Economy
6	Arjita Sikder, John Inekwe, Mita Bhattacharya	2019	changes in energy mix for G20 countries (Y), evidence by trade openness (X1) and research (X2) and development investment (X3)	Energy mix, research investment	Trade, development
7	Qiang Wang, Shuyu Li, Zhanna Pisarenko	2020	Heterogeneous effects of energy efficiency (X1), oil prices (X2), environmental pressures (X3), R&D investment	Investment, G20	Energy efficiency, oil prices, environmental pressures, renewable energy policies

			(X4), and renewable energy policies (X5) - evidence from G20 countries (Y)		
8	Xingyuan Yao, Xiaobo Tang	2020	Financial structure (X1) affects CO2 emissions (Y): Evidence from G20 countries (X2)	CO2 emissions, G20	Financial structure
9	Seyfettin Erdogan, Seda Yildirim, Panggilan Durmus, et al	2020	The effect of innovation (X) on sectoral carbon emissions (Y)	Carbon emissions	Innovation
10	Jian Dong Chen, Qin Xian, Jixian Zhou, Dingli	2020	Impact of income inequality (X) on CO2 emissions (Y) in G20 countries	CO2 emission	Income inequality
11	Hui Qiao, Fengtian Zheng, et al	2019	The greenhouse effect (Y) from the relationship between agriculture (X1)-economic growth (X2)-renewable energy (X3)	Greenhouse effect, agriculture, renewable energy	Economic growth

RESULT AND DISCUSSION

The author has conducted a review of the literature that has been collected. After the literature collection process was carried out, the authors then filtered the literature using PICOC and information collection criteria in order to obtain literature that could be assessed as appropriate according to research needs. For this reason, the following are the results of a literature review

The general characteristics of the review literature, in the year the article was published starting from 2019 at 18%, 2020 at 63%, 2021 and 2022 at 9.5%. All data in this study is in the form of literature that has a correlation research design, where literature that discusses carbon emissions (CO2) or renewable energy is as much as 80% and literature about investment is as much as 20%. A total of 11 articles were selected from the 30 articles used in this literature review, most of which came from the Scopus journal.

Analysis of the 11 articles are as follows: (1) (Kuramochi et al., 2021) stated that the impact of the Covid-19 pandemic will contribute to emissions but cannot be certain, but there will be a reduction in emissions until 2030. The reason there will be a reduction in carbon emissions in 2030 is due to increased climate action taken by G20 countries. Actions taken to reduce carbon emissions align with the pathway towards the Paris climate goals. This study also found that when the economy rises, CO2 emissions will also increase, then major fuel producers such as Iran and Kazakhstan are estimated will issue large emissions in 2030, this can happen if you don't use renewable energy immediately.

(2) (Lu et al., 2019) Assessing the relationship between CO2 emissions and economic growth in the G20 using the panel unit root test, pedoroni panel cointegration test, FMOLS estimation, and Grager's VECM causality test, the

results of which show that if consuming renewable energy such as biofuels grows 1%, then CO2 emissions decrease by 0.061% . This means that the use of renewable energy in the world of tourism investment has a good impact as the main driver of reducing existing carbon emissions. because the increasing promotion of renewable energy used for the tourism sector can develop tourism itself, especially in G20 countries. This research contributes as evidence that the application of renewable energy is worth encouraging and using.

(3) (Churchill et al., 2022) providing empirical analysis that the CO2 emission factor does affect tourism growth, especially in developed countries, the authors suggest that taxes intervene in policies regarding carbon emissions. Taxes help drive the tourism industry especially in green tourism places where taxes will indirectly invest by reducing carbon emissions in the future. The world economy needs at least 90 trillion dollars for investment in infrastructure development to support a sustainable economy in 2030.

(4) (Li et al., 2021) The cross-sectional heterogeneity and dependence test shows that economic growth can increase carbon emissions by 0.145% with a connotation level of 1%. Furthermore, the level of impact also reaches 1%, energy consumption that is not environmentally friendly increases carbon emissions by 1.178%. and urbanization contributes 10% to the increase in carbon emissions. Along with that one-way causal relationship is proven from the existence of foreign investment in renewable energy policies that help minimize CO2 emissions.

(5) (Kong et al., 2022) using the STIRPAT model and SSP scenario to simulate possible CO2 emission pathways in the G20 countries. The result is that world CO2 emissions cannot peak in the SSP baseline scenario, but if in the SSP-3 scenario if they consume high fossil energy, then the 13 countries in the G20 including China, USA and the UK can reach CO2 emission peaks while Saudi Arabia does not. Finally, optimizing renewable energy can reduce CO2 emission times and help sustainable development.

(6) (Sikder et al., 2019) Examine the long-term effects of renewable energy and investment for its development using a panel estimation method that takes into account heterogeneity. The results show that the G20 needs to continue to promote investment in research and development in the renewable energy sector in order to create sustainable development. Because the G20 economies have been able to take the lead in the transition to renewable energy at affordable prices through technological innovation to address world energy challenges

(7) (Wang et al., 2020) Helping us to understand the heterogeneous effects of renewable energy consumption can be useful for the development of more appropriate strategies to promote renewable energy. The output of his research shows that the influence of RnD investment can be a major contributor in encouraging the development of renewable energy, especially for countries that are still developing. Meanwhile, the policy itself is the main consumption contributor for renewable energy so that it can increase state revenue.

(8) (Yao & Tang, 2021) Assessing the effect of financial structure on CO2 emissions in the G20 countries. Empirical results state significant heterogeneity between developed and developing countries in the effect of financial structure on carbon emissions per capita. The financing ratio in question has a negative correlation when CO2 emissions increase in developed countries, while in developing countries it will have a positive correlation. Even so, both developed and developing countries still

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have to achieve green development through renewable energy in order to find a balance in their financial structure.

(9) (Erdoğan et al., 2020) states that on average the G20 prioritizes policies that reduce CO2 carbon emissions and increase the use of renewable energy without reducing the performance of economic growth. Progress in innovation is the main key in this research. The results state that the EKC (Environment Kuznets Curve) hypothesis is invalid, and in the long - term innovation has no significant effect. It was found that while the innovation only lowered the level of CO2 carbon emissions, it was therefore still necessary to recommend the use of renewable energy.

(10) (Chen et al., 2020) Saying that the G20 countries have experienced rapid economic growth but the income gap has also widened and the environment has also deteriorated. Increased CO2 emissions do not help equal distribution of income. Based on empirical results, reducing income inequality can be achieved through sustainable development. Namely through the use of renewable energy to reduce carbon CO2 emissions. Development with minimal CO2 carbon emissions and a sustainable economy is widely considered to be a desirable global goal. With the use of renewable energy, a green economy is realized and can strengthen cooperation between countries through investments.

(11) (Qiao et al., 2019) In his study, he wanted to examine the relationship between agriculture, economic growth, renewable energy, and CO2 carbon dioxide by using the root test, cointegration test, and panel squared (FMOLS) estimation. The results show that there is a long-term relationship between agriculture which increases CO2, and renewable energy reduces CO2 emissions so that the economy can progress

CONCLUSIONS AND SUGGESTION

This research leads to a systematic literature review so that the authors expect an open discussion regarding the use of renewable energy for investment in the G20 countries. Of the eleven articles that have been published, there are 5 authors who state that there is a significant relationship between economic growth and increased carbon emissions. This occurs because many countries still use non-environmentally friendly energy in economic activities, plus the policy on carbon emissions taxes is not yet complete. implemented in several G20 countries

Then 6 other authors argued that the use of renewable energy could reduce carbon emissions without having to reduce economic growth, (Wang et al., 2020) also added that the use of renewable energy could increase state revenues.

What's more, the authors hope that this paper will be useful for future researchers who wish to examine more deeply about renewable energy and its effect on investment

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