

G20 DECLARATION COMMITMENT TOWARD REDUCING CARBON EMISSION LEVELS

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Abstrak

Meningkatnya tingkat emisi global negara di dunia, mendorong kelompok Group of 20 (G20) untuk melakukan mitigasi peningkatan emisi melalui komitmen energi dan perubahan iklim. Namun, semakin banyaknya komitmen energi dan perubahan iklim pada KTT G20, penurunan tingkat emisi dunia belum menunjukkan tanda – tanda memuaskan. Hal ini menjadi pertanyaan bagaimana hubungan tingkat komitmen G20 tersebut dan kondisi nyata negara G20.

Penelitian ini bertujuan untuk menganalisis dan mengkaji komitmen energi dan perubahan iklim pada negara G20 beserta indikator terkait seperti GDP, tingkat persentase bauran energi terbarukan, intensitas energi, konsumsi energi dan implementasi kebijakan Nilai Ekonomi Karbon (NEK). Penelitian ini menggunakan pendekatan kuantitatif dengan melihat hasil regresi data panel dari negara G20 selama kurun waktu 2008 – 2020. Hasil menunjukkan bahwa komitmen energi G20 LD tidak berpengaruh. Namun, komitmen perubahan iklim berpengaruh signifikan terhadap emisi CO₂. Lebih lanjut, kontributor nyata penurunan ini terletak pada para komitmen perubahan iklim yang langsung menjawab tantangan kenaikan suhu dibanding komitmen energi yang membutuhkan waktu yang lama. Selain itu model yang dihasilkan menunjukkan indikator energi terbarukan dalam bauran energi dan PDB pada suatu negara juga berpengaruh signifikan dalam mengurangi CO₂. Total, konsumsi energi dan penerapan carbon pricing masih menunjukkan kontribusi positif terhadap peningkatan emisi CO₂. Penelitian ini menyarankan pentingnya negosiasi untuk aksi yang nyata dan cepat, implementasi energi yang lebih bersih dan ekonomi yang lebih hijau. Selain itu, hasil penelitian ini dapat menjadi referensi penyusunan kebijakan publik dalam mencapai penurunan tingkat emisi karbon.

Kata Kunci: Group of 20 (G20) Leaders' Declaration, Transisi Energi, Perubahan Iklim, Emisi Karbon Dioksida, Multilateralisme.

Abstract

The increasing level of global emissions of countries in the world, encourages the Group of 20 (G20) group to mitigate the increase in emissions through energy and climate change commitments. However, with the increasing number of energy and climate change commitments at the G20 Summit, the decrease in world emissions has not shown satisfactory signs. This raises the question of the relationship between the level of G20 commitment and the real conditions of the G20 countries.

This research has a purpose to analyze the energy and climate change commitment in G20 countries with related indicators like GDP, renewable energy mix percentage, energy intensity, total energy consumption and the implementation of carbon pricing policy. This research uses the quantitative approach with data panel regression of G20 country data in the period 2008 - 2020. The research finds that the commitment of energy G20 LD does not affect the real CO₂ emission while the climate change commitment does. This shows that climate change commitments directly address the temperature problem while energy commitments require a longer time. Furthermore, this research also shows the real contributor by the share of renewable energy in the energy mix and GDP. Total energy consumption and carbon pricing implementation still show a positive contribution to the increase of CO₂ emission. These researches suggest the importance of negotiation with concrete and faster results, greener and cleaner energy and economic

implementation. In addition to that, the result can be a reference in issuing public policy toward reducing carbon emission levels.

Keywords: *G20 Leaders' Declaration, Energy Transitions, Climate Change, Carbon Dioxide Emission, Multilateralism.*

1. INTRODUCTION

Climate change is very closely related to the level of greenhouse gas (GHG) emissions in the world. According to the Ministry of Environment and Forestry of Indonesia, GRK consists of several gasses where 75% of which is contributed by carbon dioxide gas (CO₂). The accumulated amount of GHG in the atmosphere increases the amount of sunshine that does not return and leads to an increase in the temperature of the earth's surface. This increase, which has been present for more than a century, has a serious impact on climate change and endangers the lives of living things. Hunger, extinction, increasing sea levels, and the melting of polar ice are the first. Based on studies, the Intergovernmental Panel on Climate Change (IPCC) has determined that in order to prevent irreversibility.

With the current increase of global temperature reaching 1.2C, countries across the world are to overcome the impact. G20, a forum constituted of the 20 biggest economies in the world (South Africa, Brazil, Russia, India, China, Mexico, Indonesia, Turkiye, Australia, South Korea, Saudi Arabia, Argentine, USA, UK, Canada, Japan, Germany, Italy, France, and European Union) work together and discuss the prominent agenda of energy and climate change, especially in mitigating and reduction of CO₂ emission which affected the temperature rise.

People believe that the actions of G20 countries will contribute greatly as the G20 constitutes 75% of global trade, 2/3 world population, and 80% GDP in the world (Oxfam, 2012). (Kemp, 2011) on his research found that CO₂ emission increases in parallel with the growth of industrialization, energy demand, and daily activity of the people. Strehse, 2009 found that fossil fuel, GDP, and energy intensity contributed to the increase in CO₂ emission. Hui in 2019 also found that renewable energy in the energy mix is inversely proportional to CO₂ emission growth. The G20 country, to answer the challenges, has declared several commitments, especially in energy transition and climate change with the hope to reduce CO₂ emission in economic activities. There have been many initiatives and commitments since the holding of the first G20 summit in 2008 like the reduction of the use of Hydrofluorocarbon, an initiative to phase down fuel, mobilization of funds from developed to developing countries, using all alternative ways to transition, and so on. As the G20 commitment is going up, the CO₂ emission still does not show some decent news. IEA, in 2022 has shown a tremendous increase of emission of CO₂ resulting from industry activities across the globe.

This research will limit the problem with a focus on G20's current indicators showing the current policies/indicators and its commitment to G20 LD. Variability of indicators covers the renewable energy share, GDP, total energy consumption, carbon pricing variable, energy and climate change paragraph in G20 LD, and energy intensity, which are refined from related past research. This research will take inspiration from Akram 2011, who calculated CO₂ emissions in ASEAN. Based on past research in

calculating CO₂ emission from a country, this research will extend the study of indicators from the first summit of G20 in 2008 in Washington to the G20 Summit 2020 in Riyadh. The research methodology uses quantitative and qualitative approaches based on positive philosophy. Reputable sources including the World Bank, IEA, and G20 secretariat provided the data.

Based on this phenomenon, this research aims to analyze the energy and climate commitment in G20 LD along with indicators such as renewable energy share, energy intensity, total energy consumption, carbon pricing policy implementation, and GDP from each G20 country. Hopefully, this research will give insight and proof of how a nonbinding commitment affects the goal of multilateralism, in this case of CO₂ emission, and can shape future discussion and coordination in domestic and international fora.

2. METHODS

This research uses a quantitative and qualitative methodology based on philosophical positivism to examine a certain population or sample, gather data using tools for research, and evaluate data in light of predetermined hypotheses (Sugiyono, 2017). The aim of this research is to quantitatively assess the G20 LD's energy and climate commitments. To do this, data panel regression will be used, regressing each country's independent variable to determine the correlation. The outcome will display how the factors relate to one another. The research model is as follows

$$CO_{2t} = \alpha_1 + \sum_{i=1}^k \beta PE_{it} + \sum_{i=1}^k \beta IE_{it} + \sum_{i=1}^k \beta TKE_{it} + \sum_{i=1}^k \beta GDP_{it} \\ + \sum_{i=1}^k \beta NEK_{it} + \sum_{i=1}^k \beta KE_{it} + \sum_{i=1}^k \beta KP_{it} + \epsilon_t$$

Legend.

CO_{2t}	: Carbon Dioxide Emission;	PE	: Renewable Energy Share;
α_1	: Constant;	IE	: Energy Intensity;
β	: Coefisien;	TKE	: Total of Energy Consumption;
ϵ	: <i>Error</i> term;	GDP	: <i>Gross Domestic Product</i> ;
i	: country;	NEK	: Carbon Pricing;
t	: year;	KE	: G20 LD energy commitment;
		KP	: G20 LD climate change commitment;

Data used based on data panel form where the cross of the variable and series of data in certain years combined (2008 - 2020). 2008 is designated as the year of the G20 summit and 2020 as the most complete data ever taken. The method follows the test of classical assumption including correlation test, determination test, F test, T-Test and followed by the select most appropriate data panel model, which is: Model Pooled Least Square (PLS), Model Fixed Effect (FEM), Model Random Effect (REM). These appropriate models will be selected after tests by Chow Test, Hausman Test, and LM Test (Gujarati, 2009).

Table 1 - Summary of Variable Used

No	Variable	Definition	Hypothesis	Unit
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1	Renewable energy share in energy mix	A share of renewable energy supply (hydro, wind, geothermal, solar and others) in total energy consumption of a country.	The increase of renewable energy share in energy mix will decrease the CO2 emission in a country	(%)
2	Energy intensity	Energy intensity is a measurement of energy consumption per unit of GDP. This will show the indicator of energy efficiency of a country.	The increase of energy intensity will show a negative proportional increase of CO2 emission	(TES/GDP)
3	Total energy consumption	The total energy consumption of a country is measured in the term of a million of fuel. This includes the electricity consumption of a country	Energy total consumption contribute positively to the increase of CO2 emission	(MToe)
4	GDP	GDP (US\$) is a measure of market value from all the goods and services produced in a country for a year.	GDP contribute positively to the increase of CO2 emission	(US\$)
5	G20 Energy LD Commitment	Data of energy transition commitment of G20 LD which count the number of paragraph/initiatives like: Energy, Renewable, Transitions, Power, Nuclear		unit
6	G20 Climate Change LD Commitment	Data of climate change commitment of G20 LD which count the number of paragraph/initiatives like Climate, Green, Emission, Greenhouse, UNFCCC, Paris Agreement		unit
7	Carbon Pricing Policies implementation	Dummy data for a carbon pricing scheme implemented by a country. Yes or no will be referred which include Emission Trading System, carbon offsetting, carbon tax and other forms of carbon pricing		unit

3. RESULT AND DISCUSSION

To select the most appropriate model in the data panel, Chow Test, Hausman Test and LM Test have been conducted. Chow test is used to choose whether common effect or fixed effect is more accurate to describe a data panel. Hausmann tests itself to select between fixed effect and random effect. The result are as follows:

Chow Test

Table 2 - Chow Test Result

Result	Criteria	Information
Probability 0.0000	If the Cross-section Chi-Square < 0.05 choose Fixed Effect vice versa	Fixed Effect is selected over the common effect

Hausman Test

Table 3 - Hausman Test Result

Result	Criteria	Information
Probability 0.0000	P Value < 0.05, choose Fixed Effect vice versa	Fixed effect is selected over the random effect

With the selected model from the test in table 6 and 7, the most accurate model is fixed model, thus, the model are as follows:

$$\begin{aligned}
 CO2\ emission = & -9876.676 * RENEW_{SHARE} - 0.0000000559 * GDP \\
 & + 3211.065 * TOT_{ENERGY} + 59060.44 * NEK_{POLICY} \\
 & - 620.05 * Climate_G20
 \end{aligned}$$

The data from 2008 - 2019 from 20 countries in G20 has been tested by classical assumption. The data will undergo several tests such as autocorrelation test, normality test, multicollinearity test and heteroskedastic test. This to fulfil the BLUE (Best Linear Unbiased Estimator) standard for more justified results. The result as follows:

Table 4 - Classical Assumption Test

Type of Tests	Results	Information
Autocorrelation Test	There is positive autocorrelation and there is no negative autocorrelation	Some of data comes from previous years such as GDP
Normality test	Data is normally distributed	Jaque Bera 14.29033 Probability 0.000789
Multicollinearity Test	There is no multicollinearity.	No correlation more than 0,7 and -0,7
heteroskedasticity Test	No Heteroskedasticity	

After the classical assumption test, the regression result showed by Figure 4, The explanation from the regression findings are as follows:

- From the approach of T test and F Test, the F test is 14722.89 and the probability is 0.0000. This shows the variable contributes simultaneously and affects the dependent variable. From T-statistics, the variables that contribute significantly to CO₂ emission are only renewable energy share, GDP, Total consumption of energy and NEK policy where the value is under α % (0,5).

b. From point a it can show that:

- i. GDP has a significant effect on CO₂ levels negatively. Every addition of 1US4 to the GDP, there is a reduction of 0.0000000559 kt or 559 μ CO₂. It has α under 0.05. This is in accordance with what Akram said in its research (2011) that GDP negatively affects CO₂ emission. This suggests the G20 countries are on track for a green economy where the increase of GDP will lead to decrease of CO₂ emission proportionally. But, Dietz in 1999, showed different results as they mentioned that GDP is in the same direction of the increase of the CO₂ emissions. Yao in 2014 emphasized that GDP growth may vary between developed and developing countries, including G20. Developed countries tend to refer to and consider the environmental impact during economic activities.
- ii. Renewable energy mix significantly affects the emission of CO₂ negatively. Every 1% increase of renewable energy share in the energy mix of a country, the emission will reduce 9876.676 kt CO₂e. It has α under 0.05. This is in accordance with theory as renewable energy has a zero emission in their process. This includes the use of Hydro, Wind, Geothermal and solar that produce energy without involving fossil fuel in the process. Hydro energy uses the potential energy gained in the waterfall or river course to move the turbine. This goes the same way in wind turbines and geothermal that are moved by wind and steam respectively. Solar panels gain the voltage differences after solar shine to photovoltaic components that move electrons forwards and create voltage differences thus generating electricity.
With the increase of renewable energy in the energy mix in the grid, will affect the CO₂ emission of a country to decrease considerably. Hui in its research in 2019, emphasizes that renewable energy has significantly decreased the CO₂ emission in developed and developing countries.
- iii. Energy intensity does not significantly affect the CO₂ emission in G20 Countries. It has α above 0.05 which is 0.385. This show whether the energy intensity is up or down, does not affect the CO₂ emission in a country
- iv. Energy total consumption contributes to the increase of CO₂ emission. Every 1 MTOE of total energy consumption will affect the increase of CO₂ emission 3211.065 ktCO₂e. It has α under 0.05. This is in accordance with what Stresha found in his research in 2019, where the total energy consumption directly affects the rise of CO₂ emission. This is supported by the research of Al Maluli in 2012, with his research in middle eastern countries where the dependence of fossil energy has shown considerable increase of CO₂ emissions. The rise of energy total consumption to CO₂ emission shows the G20 countries still have a dependency to fossil fuel that led to the product of CO₂ emission during the activity.
- v. Carbon pricing implementation policy contributes to the CO₂ emission positively. When this policy is implemented, there is an increase of 59.060 MT CO₂. It has α under 0.05. This has a different result to what Parry, 2021 find where the combination of carbon tax and other instrument has effectiveness of 70% in reducing carbon emission. But as

Leonardo said in his research in 2020, some of policies may not adopted well that resulted to leakage and lack of good implementation. Some theory suggests the leakage and additionality may not fully monitored. The aspect of greenwashing also has some good answer where the net of carbon emission is reportedly negative as the result of carbon credit bought. This demonstrates the user/company can do emission activity and atonement its sin by buying credit carbon from other side of planets. This results the CO₂ emission exist and increase

- c. Commitment of Energy also does not significantly affect the CO₂ emission as the α is above 0,05. The climate change commitment is significantly affected as the α is under 0,05 (0,0462). This is in accordance to what John Kirton research in 2021, where he suggests the commitment of G20 has been complied especially in the aspect of climate change. He suggests the commitment and target should be done more ambitious. The commitment of energy may take several decades as the coal and fuel right now still dominates the energy supply in many major countries (Li, 2020). As the economic growth and energy resilience become a major reference, the energy commitment may slow and do not have yet a significant influence to CO₂ emission. On contrary, climate change commitment addresses directly with closer target to energy such as NDC achievement in 2030. Climate change commitment also show alignment to Paris Agreement para that has been operationalized in 2021 (In Indonesia, the agreement is ratified in 2016). Some real implementation of climate commitments is fund mobilization, the creation of a carbon market and carbon offsetting, promoting nature and ecosystem-based solutions and stocktaking emission to track real progress of CO₂ emission from its country (MoEF of Indonesia, 2021).
- d. The Coefficient of determination R², shows the value of 0,999392. This implies that the model has accuracy of 99,99% as the variable successfully can cover all the model.

Table 5 - Variable Result in Regression

Analysis of the Regression			
No	Independent Variable	Direction	Interpretation
1	Constants	-	Not Significant
2	Energy Intensity	+	Not Significant
3	G20 LD Energy Commitment	-	Not Significant
4	G20 LD Climate Change Commitment	+	Every increase of 1 LD G20 Climate Change, there is a decrease a CO ₂ emission about 620 ktCO ₂ e
5	GDP	-	Every increase of 1US\$ of GDP, there is a decrease a CO ₂ emission about 559 μ CO ₂ e
6	Carbon Pricing Implementation	+	Every carbon pricing implemented, there is an increase of CO ₂ emission 59 MT CO ₂ e
7	Renewable Energy Share in Energy Mix	-	Every 1% increase of renewable energy share in energy mix, there is a decrease of 9876 ktCO ₂ e emission
8	Energy Total Consumption	+	Every increase of 1MTOE of total energy consumption, will lead to the increase of CO ₂ emission 3211.065 kTCO ₂ e

G20 LD Commitments

The commitment of energy and climate change in G20 LD as follows:

Table 6 - G20 Energy and Climate Change Commitment over the year

No	G20 Presidency Year	Energy			Climate Change		
		Total of Paragraph	Energy Commitment Paragraph	Percentage of Commitment	Total of Paragraph	Energy Commitment Paragraph	Percentage of Commitment
1	2008	1	1	1.05%	1	1	1.05%
2	2009	5	54	2.3%	4	42	1.85%
3	2010	1	3	0.45%	3	15	1.4%
4	2011	5	10	1.77%	5	28	1.77%
5	2012	3	6	1.6%	3	39	1.67%
6	2013	11	48	3.9%	3	26	1.06%
7	2014	2	10	0.97%	2	8	0.97%
8	2015	4	20	3.4%	2	18	1.7%
9	2016	2	27	4%	4	48	1%
10	2017	5	20	7.9%	3	24	4.1%
11	2018	2	14	8.5%	3	16	3.1%
12	2019	5	30	6%	4	43	9%
13	2020	3	17	4%	6	37	3%

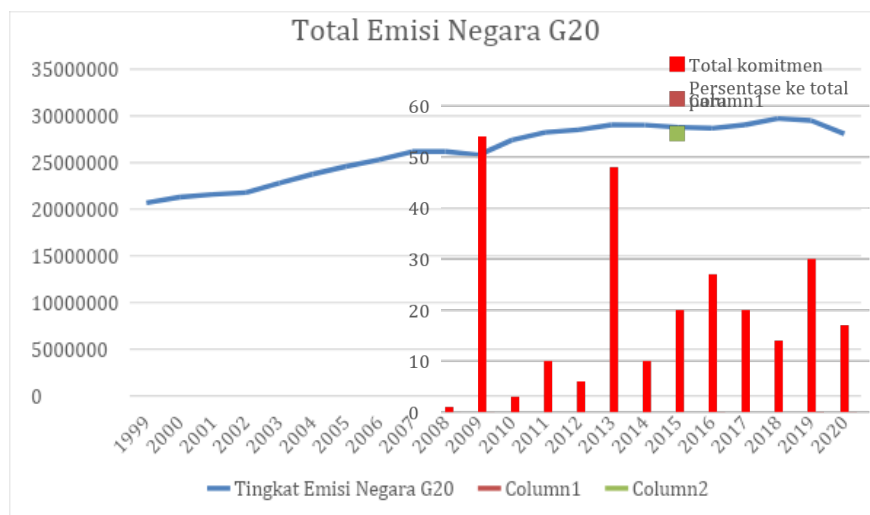


Figure 1 - Associative Comparison how Energy Para Commitment in number to the real CO2 emission in the G20 Countries

The energy and climate change paragraphs commitment has been showing its way to the attention of G20 Countries. In the same year, the commitment reaches between 1-8% of the total commitment within the leader declaration. Compared with CO2 emission year by year and the model, the fluctuation of energy commitment in G20 LD, even though it tends to increase, has no direct impact on the level of CO2 emission to the world. This finding is strengthened by the significance which is categorized as not significant in the level of CO2 emission contribution.

This goes a bit differently with climate change paragraph commitment where it is significant in reducing CO₂ emission. The energy commitment still not yet has taken effect as the consensus said that the energy phasing down of fossil fuel will be done gradually. This is caused by the consideration of the importance of economic growth and energy resilience (Li, 2020). It can be understood that some of the climate change directly addresses the climate change problem like biodiversity, land use, CO₂ emission, the need for mobilization, the use of nature and the ecosystem as a solution, and other measures.

4. CONCLUSION

This research regarding CO₂ emission to the G20 countries and its variable have concluded things as follows:

1. Energy and Climate Change commitment in G20 is a consensus of G20 countries. Although the result of a commitment to energy is varied and tends to increase, it does not significantly reduce CO₂ emissions in the world. The commitment and initiatives are very much on top of the paper such as the phasing down of fossil fuel, the importance of energy resilience, diversification, technology scaling up, fund mobilization, and others. The delay of time, cost and periods such as retirements of Coal Power Plant that need a decade, will delay the implementation of energy pledges. Observing further the nonbinding character of the G20 forum's declaration. On the other hand, climate change commitments significantly affect CO₂ emission. Taking a look at the commitment, the addressing para is directly towards how to reduce carbon emissions such as the transfer of technology, fund mobilization, use of mitigation and adaptation efforts (including environment and natural solutions), and the acknowledgment of the Paris Agreement.
2. The relationship between those indicators to the G20 emission is as follows:
 - a. GDP has a significant effect on CO₂ negatively. Every addition of 1US\$4 to the GDP, there is a reduction of 0.0000000559 kt or 559 μ CO₂.
 - b. Renewable energy mix significantly affects the emission of CO₂ negatively. With every 1% increase of renewable energy share in the energy mix of a country, the emission will reduce 9876.676 kt CO₂e.
 - c. Energy intensity does not significantly affect the CO₂ emission in G20 Country
 - d. Energy total consumption contributes to the increase in CO₂ emissions. Every 1 MTOE of total energy consumption will affect the increase of CO₂ emission 3211.065 ktCO₂e.
3. Carbon pricing implementation contributes to CO₂ emissions positively. When this policy is implemented, there is an increase of 59.060 MT CO₂

This regression result demonstrated an interesting finding. The renewable energy share in the energy mix is proven to contribute to the reduction of emissions of G20 countries. The negative contribution of GDP implied that most of the G20 is on the right track to the green economy / low carbon activities. On the other hand, the consumption total and carbon pricing implementation demonstrated a positive contribution to CO₂ emission. This is allegedly said that in total energy consumption still relies on fossil fuel (IEA, 2023), and the practice of “greenwashing” where there is a leakage in the carbon market. As the reduction takes place, the excess will be added in other places or simply the company/individual still do a high intensity of carbon, while doing atonement by buying carbon credit in other places.

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