ISSN: 2338-8412 e-ISSN : 2716-4411

Ekombis Review – Jurnal Ilmiah Ekonomi dan Bisnis
Available online at : https://jurnal.unived.ac.id/index.php/er/index
DOI: https://doi.org/10.37676/ekombis.v14i3

The Role Of Banking Financial Technology In Reducing GHG Emissions: A Study Of ASEAN Banks

Herlina [1)], Matius Surya Mulyana [2)]
[1)]Program Accounting , Universitas Ciputra, Jakarta, Indonesia
[2)]Faculty of Technology and Design, Bunda Mulia University, Jakarta, Indonesia
Email: [1)] herlina.lina@ciputra.ac.id

How to Cite :
Herlina., Mulyana, M, S. (2026). The Role Of Banking Financial Technology In Reducing GHG Emissions: A Study Of ASEAN Banks. EKOMBIS REVIEW: Jurnal Ilmiah Ekonomi Dan Bisnis, 14(3). DOI: https://doi.org/10.37676/ekombis.v14i3

ARTICLE HISTORY
Received [19 August 2025]
Revised [14 July 2026]
Accepted [18 July 2026]

KEYWORDS
Greenhouse, Financial Technology, ASEAN Banks.

ABSTRACT

Technological advancements facilitate the mitigation of Greenhouse gas (GHG) emissions. Technological advancements in the economic sector yield diverse breakthroughs and enhance managerial efficacy, fostering favourable economic expansion. The banking business is a key economic sector that has the potential to promote and encourage ESG. The banking business is committed to enhancing ESG as banks own financial instruments that support ESG and permeate all facets of their business. Sustainable financial technology reduces greenhouse gases by supporting ESG. The research question formulated in this study is whether the implementation of sustainable financial technology in ASEAN countries has an impact on GHG emissions. The research sample included 25 banks in ASEAN. The research utilises secondary data as sustainable financial report documents from 2019 to 2021. A total of 75 panels were included in this study. Using sustainable financial technology benefits GHG emissions, with a statistical significance of 1%. The impact of implementing sustainable financial technology on GHG emissions is 24.7845%.

INTRODUCTION

What is the purpose of the study? Why are you conducting the study? The main section of an article should start with an introductory section, which provides more details about the paper's purposes, motivation, research methods, and findings. The introduction should be relatively nontechnical, yet clear enough for an informed reader to understand the manuscript's contribution. Technology plays an important role in promoting economic development and attaining sustainability. The utilisation of technology has the potential to induce substantial transformations in economic processes, particularly in office administration, and enhance efficiency across various sectors of the economy. The scope of the digital economy includes various economic activities and production elements associated with digital information and communication networks interconnected through the Internet . The advent of digital technology

has had a profound effect on the framework of the economy that is built on digital platforms. The digital economy, frequently known as the internet-based or online economy, encompasses economic activity conducted electronically through the internet network, encompassing various transactions and company operations. Utilising technology in the economy can decrease GHG emissions. The utilisation of computer technology in economics can lead to a reduction in GHG and impact economic growth.

The digital economy offers a potential option for mitigating carbon emissions by leveraging digital financial technology or sustainable financial technology to establish a sustainable system for conserving energy and lowering emissions. The financial industry is currently undergoing a transition from traditional finance to digital-based finance. This transition aims to effectively regulate the use of funds, enhance policy effectiveness, and contribute to reducing GHG emissions. In the Banking Sector, technology has an important role to improve bank performance, improving efficiency, promoting environmental friendliness, and fostering sustainability. Sustainable Financial technology refers to the application of financial technology in sustainability. Sustainable Financial technology arises from integrating digital technology into the banking sector, encompassing a range of banking services. Sustainable Financial technology serves as a means to enhance disintermediation and efficiency, hence generating favourable perceptions of banks among clients. Implementing sustainable financial technology solutions, such as those in the banking sector, can mitigate GHG emissions. Banking services encompass the provision of Automated Teller Machines (ATM) and online Internet transactions. ATM can enhance banks' operating efficiency and minimise the necessity for physical branch offices, decreasing the environmental impact and energy usage linked to banking activities. ATM deployment facilitates financial access in remote areas and enhances individuals' access to financial services, encouraging financial inclusion and fostering economic sustainability. Digital transactions are a viable substitute for energy-intensive processes, such as energy efficiency, as they necessitate fewer resources and less energy. This aspect aligns with sustainability goals and contributes to the mitigation of environmental harm.

The integration of sustainable Financial technology in ASEAN is currently undergoing the process of achieving equalisation. ASEAN countries primarily comprise developing nations; hence, the focus on sustainable Financial technology aims to achieve balance and progress in financial services, including infrastructure and sustainable financial laws, the proportion of individuals utilising banking services in the ASEAN region remains very low as Indonesia (19 persent), Filipina (25%), Vietnam (46%), Thailand (54%), Malaysia (72%), Singapura (88%). Indicates that the utilisation of financial services still needs to be more equal and suboptimal, thus presenting significant prospects in the banking industry. The proliferation of sustainable financial technology in ASEAN is expanding with the rising consciousness of environmental and social concerns. Collaboration between governments, financial institutions, and technology businesses is being fostered to promote the utilisation of financial technologies that align with sustainability objectives and facilitate economic expansion. Implementing sustainable Financial technology in ASEAN can effectively reduce GHG emissions, especially as developing countries are prevalent in ASEAN.

LITERATURE REVIEW

Greenhouse Gas (GHG) Emissions

The period from 1995 to the present has witnessed significant environmental changes due to industrial development, which has involved the direct or indirect utilisation of natural resources. Sustainable environmental impacts result in diminished land and air quality, elevated air temperatures, and intensified air interactions that generate greenhouse gas emissions. The escalation of greenhouse gas emissions will result in the depletion of the ozone layer, posing a lethal threat to human existence on Earth. Several nations have initiated initiatives to mitigate

the release of greenhouse gas emissions. International organizations continue to reduce GHG emissions through renewable energy and energy efficiency by engaging financial and non-financial institutions to combat environmental change (Chen and Zhang, 2022). The research conducted by investigates the enduring correlation between GHG emissions and renewable energy efficiency found that there is a negative correlation between renewable energy efficiency and GHG emissions, with every 1% increase in renewable energy developed countries in Europe has contributed to the 0.003% reduction in GHG emissions. This implies that increased renewable energy sources will decrease GHG emissions.

Financial Technology

The rapid progress of digital technology has profoundly impacted business models, economies, and the lives of individuals. The advent of digitalisation presents a novel prospect to manage environmental deterioration and establish a digitalised economic framework effectively. Business digitalisation aims to enhance the financial performance of firms by leveraging the internet and knowledge, enabling seamless connectivity across geographical boundaries. Technology-based financial inclusion refers to efforts to expand people's access to and participation in the banking financial system using technology to provide more accessible, affordable, and efficient solutions. Banking services that can be accessed through electronic devices such as smartphones or computers, such as online account opening, money transfers, and bill payments. Financial inclusion innovations aim to increase access to financial services for as many people as possible, especially in areas that are difficult to reach by traditional financial institutions. People can easily access authorized financial services digitally. Digital access to financial services is referred to as technology-based financial inclusion.

Technology-based financial service systems are financial systems that utilise technology to advance environmental sustainability, enhance individuals' well-being, and mitigate greenhouse gas emissions. Technology-driven financial inclusion is considered sustainable because it can reduce greenhouse gas emissions. Furthermore, including more individuals in the financial system negatively affects inflation in immediate and extended periods. Financial inclusion can potentially mitigate inflation and enhance monetary policy within the ASEAN nations [10]. The deployment of technology-based financial inclusion is driven by the goals of the ESG programme, specifically to decrease greenhouse gas emissions and enhance welfare. According to the McKinsey Global Institute, the development of digital finance can be divided into two periods: 1890-2003 and 2003-present. The first periods witnessed the adoption of electrooxidation and informatisation by traditional financial institutions. The second periods in 2003, a significant turning point occurred with the entry of Information and Communication Technology (ICT) into a new phase, characterised by the rise of internet companies and technologies that integrate with financial services. This stage continued until the Industrial Revolution, marked by the emergence of 5G, big data, and artificial intelligence. Adopting sustainable finance will substantially impact carbon emissions by influencing economic growth, industrial structure, and technological innovation. This will enable the government to enhance its capacity to tackle carbon emissions by empowering companies efficiently and environmentally consciously.

The ESG programme incentivises banks to develop novel banking products that foster sustainable practices and revamp environmentally conscious back office procedures [13]. Banks engage in environmentally conscious practices by integrating operational enhancements and technology expertise into their banking operations. Green banking financial goods encompass online banking, mobile banking, ATM, green deposits, and green credit. Implementing these practices can effectively decrease carbon footprints by minimising paper usage, conserving energy, reducing transportation emissions, and optimising energy and resource utilisation. Sustainable Financial technology experiences a developmental trajectory that results in gradual

and transformative advancements, including Internet banking, mobile payments, crowdsourcing, peer-to-peer lending, Robo-Advisory, online identity, and other related innovations.

Bank financial products leverage technology, the Internet, and big data to offer financial services that enhance financial coverage, improve service efficiency, and lower transaction costs. This can contribute to developing a green economy and reducing carbon emissions. Implementing sustainable financial technology can have a positive impact by decreasing operational costs and improving efficiency in banking services. Additionally, it can contribute to the expansion of technical advancements in other industries, affecting GHG emissions, the environment, and the economy. Sustainable financial technology fosters the expansion of innovation. Banks must implement a range of advances in financial services. The effects of sustainable financial technology encompass several key aspects: 1) enhanced efficiency leading to cost savings in production; 2) decreased bank transaction costs, including the distribution of customer cash, negotiation of transactions, and execution of contracts; 3) improved internal management efficiency inside banks.

Chinese research findings consistently demonstrate that the digital economy has played a significant role in mitigating pollution, enhancing China's ecological environment, and fostering economic growth and. The digital economy notably enhances the industrial structure, albeit not immediately cutting carbon emissions. Nevertheless, enhancing the capability of the digital economy will facilitate the decrease in carbon emissions. The digital economy will substantially affect lowering carbon emissions when the government implements regulations that control the low-carbon economy, thus reinforcing the foundation for establishing a low-carbon economic structure. Utilising digital finance can enhance financial engagement. This study examined the impact of digital finance on carbon emissions performance in China by analysing secondary data from 2012 to 2018. The findings indicated that digital finance had several positive impacts. 1), it significantly reduced carbon emission intensity and improved emission efficiency while increasing the coverage and utilisation of digital financial digitalisation. 2), digital financial development acted as an intermediation mechanism, affecting economic growth, industrial structure, and innovation. 3), digital financial development was particularly beneficial in reducing carbon emissions in urban areas with high economic and financial development levels. The study determined the correlation between digital banking and carbon emissions using secondary data from Thailand in 2018. The findings unveiled that 1) The use of digital finance significantly affected reducing carbon emissions, depending on the extent of coverage and depth of use. 2) The financing mechanisms of digital finance could potentially decrease carbon emissions in cities. 3) Digital finance had an energy-saving and emission-reducing effect in urban areas.Studies conducted between 2011 and 2019 demonstrated that digital finance significantly affected reducing GHG emissions. Specifically, research has demonstrated that digital finance may successfully mitigate industrial pollution emissions by affecting industrial structure. Reducing pollution had two distinct levels of achievement. Once digital finance surpasses the first level, it would have a significant effect on accelerating the reduction of emissions from industrial pollution.

The study conducted by [22] investigates the relationship between financial inclusion and the Environment Kuznets Curve (EKC) by analysing panel data from 103 countries spanning the years 2004 to 2014. According to the findings, including financial services can lead to a decrease in greenhouse gas emissions. Research undertaken in industrialised countries demonstrated that the implementation of sustainable financial technology significantly affected reducing GHG emissions. The research hypothesis of this study is as follows:

H_a: The impact of sustainable finance technologies on GHG emissions.

METHODS

This study involved quantitative research that aimed to explore causal relationships. The study included a sample of 25 banks from ASEAN for 2019-2021, utilising annual data. Therefore, the total number of data points in this study was 75. The model employed linear regression analysis and simple correlation.

The variables in this study include independent variables, specifically sustainable financial technology, which is measured by the number of ATM transactions, Mobile banking, and Internet banking. Meanwhile, the dependent variable was GHG emissions, expressed in metric tonnes of carbon dioxide (CO2). Equation of this research model:

$$GHG = a + b\ SFT$$

GHG = greenhouse gas emissions
SFT = sustainable financial technology

The financing mechanisms of digital finance could potentially decrease carbon emissions in cities . Sustainable financial technology fosters the expansion of innovation. Model employed linear regression analysis and simple correlation conducted using EVIEWS, necessitating a model selection test.

The model selection test comprised the Chow test, Hausman test, and Lagrange Multiplier (LM) test, which were utilised to determine the most suitable model in data analysis and. According to the model selection test, if the selected model is either an expected or fixed effect, it is necessary to conduct a classical assumption test.

This test included the following assessments: normality test (Jarque Bera), heteroscedasticity test (Glejser), autocorrelation test (LM Test), and linearity test (Ramsey Test). However, if the random effect model is selected, there is no requirement to prove the classical assumptions.

RESULTS

The model quality test, which includes the Chow Test, the Hausman Test, and the Lagrange Multiplier (LM) test, yielded the following results:

Table 1. Selection of Research Model Quality

Testing	Probability Cross-Section	Decision Rule	Decision
Chow Test	0,0000	Prob.>0,05 [CEM] Prob.<0,05 [FEM]	FEM
Hausman Test	0,8669	Prob.>0,05 [REM] Prob.<0,05 [FEM]	REM
LM Test	0,0000	Prob.>0,05 [CEM] Prob.<0,05 [REM]	REM

Source: Processed data results from Eviews 9

According to Table 1, the Random Effect Model (REM) is the optimal model selected in this study. Therefore, this model does not necessitate a traditional assumption test. The research variables were thoroughly examined utilising a dataset of 25 bank samples from ASEAN countries between 2019 and 2021. The independent variable is sustainable digital finance, represented by proxies such as ATM, mobile banking, and Internet banking, measured in terms of transaction units. The dependent variable is GHG emissions, measured in metric tonnes of CO_2 generated. The outcomes of processing descriptive statistical data are as follows:

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Dev
Banking Financial technology	75	2.0600818	7.4051243	5.05654242	1.39385195
GHG emissions	75	2.6691029	6.9919667	4.49273060	.730680852

Table 2. indicated that the mean, median, and standard deviation values demonstrated that the value of sustainable finance technology was above that of GHG emissions. From the perspective of standard deviation, digital finance exhibits more significant variability than GHG emissions. The data was processed using the Random Effect Model (REM) to assess the impact of sustainable financial technology on GHG emissions. The analysis used a 75-panel dataset comprising a three-year time series and 25 institutions.

Tabel 3. Metode Panel EGLS (*Cross-section random effects*)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.959479	0.332939	8.888960	0.0000
Banking Financial technology	0.303221	0.062240	4.871771	0.0000
R-squared	0.247845			
Adjusted R-squared	0.237541			
S.E. of regression	0.362690			
F-statistic	24.05442			
Prob(F-statistic)	0.000006			

According to Table 3. The coefficient value of Banking Financial technology is 0.303221, indicating a high level of significance with a probability of 0.000. This figure indicates that implementing sustainable financial technology has a notable 1% beneficial impact on GHG emissions. Equation of this research model: GHG emissions = 2,959479 + 0,303221 of Banking Financial technology

This demonstrates that as sustainable financial technology increases, the bank's ability to reduce GHG emissions will also increase. The R-squared value is 0.247845, indicating that 24.7845% of the variation in the generation of GHG emissions can be explained by implementing sustainable financial technologies. The F-statistic has a value of 24.05442 and a probability (F-statistic)) of 0.000006. This score indicates that the regression model is appropriate for doing research analysis.

DISCUSSION

This study employed the Eviews statistical programme to examine the impact of sustainable financial technology on GHG emissions. The analysis was based on model selection outcomes utilising secondary data from sustainability financial reports for 2019-2021. The data pertains to 25 banks in the ASEAN region. The selected model for this research was the Random Effect Model (REM). Applying sustainable financial technologies was found to have a favourable impact on GHG emissions. This demonstrated that a broader implementation of sustainable financial technology led to more GHG emissions effectively decreased by banks. The findings of this study align with the outcomes of research carried out in China, and, which demonstrate that the implementation of financial technology can effectively decrease GHG emissions. The findings of indicate that financial inclusion can mitigate greenhouse gas emissions. According to the study conducted by, research findings in ASEAN demonstrate that energy-efficient infrastructure, digitalisation, and financial inclusion have a substantial impact on reducing the ecological footprint. Nevertheless, the greenhouse gas reduction was at 24.7845%, indicating a modest decrease. The limited reduction in GHG emissions in ASEAN can be attributed to the predominance of developing countries within the region, which are currently focused on

achieving fair and sustainable development. The ASEAN countries are currently undergoing sustainable development; however, it has yet to be uniformly spread throughout all countries [30]. The sustainability implementation level in ASEAN countries needs to be improved and requires further growth. ASEAN countries possess a favourable prospect to serve as sustainable business arenas by capitalising on the prospects presented by the SDGs. The first advantage is the commercial opportunity to meet global energy demands by promoting economic growth through cross-border electricity exchange through the ASEAN Power Grid (APG). Furthermore, it is crucial for ASEAN countries to cooperate in climate policy due to their heightened susceptibility to the impacts of climate change. Policies targeting the reduction of GHG emissions in the energy sector and using technology can effectively mitigate climate change. The study conducted by examines the digitalisation process aimed at promoting financial inclusion in ASEAN countries, specifically Cambodia, Indonesia, Laos, Myanmar, the Philippines, and Vietnam. The research focused on medium and lower-income populations and employs the Diffusion of Innovation (DOI) theory. The findings indicated that digitalisation is necessary in the lower middle-income population since it significantly affects enterprises' ability to obtain domestic loans from banks.

The study findings indicate that ASEAN collaboration in promoting economic growth increases GHG emissions. To address this issue, ASEAN should implement policies that promote using renewable energy sources, such as hydroelectric power plants, and impose substantial taxes on electric cars. The research findings indicate that ASEAN policies focused on power generation can potentially decrease GHG emissions, as stated in references and. The study conducted by demonstrated that digitalisation-driven financial inclusion has the potential to mitigate greenhouse gas emissions effectively over time. To optimise the reduction of such emissions, ASEAN nations must enhance their technology-based infrastructure across diverse economic sectors, encompassing production processes and corporate management.

This study's findings align with earlier research, indicating that the utilisation of technology has a discernible effect on mitigating GHG emissions. Nevertheless, the reduction remains very modest, amounting to approximately 24.7845%. This suggests that there is still room for improvement in optimising the performance of this reduction. The outcome is a promising indication for banks to enhance the sustainability of technology-driven financial services. Implementing technology-driven financial services enhances bank performance and provides significant opportunities for individuals in rural and urban locations to engage in diverse banking activities. Furthermore, these findings can bolster government initiatives to achieve technological equity, such as ensuring universal internet access across the nation, thereby enabling more efficient support for sustainability efforts. The results of the study, revealed that the determination of sustainability policies in ASEAN will have an impact on GHG emission reduction, so governments need to pay detailed attention to the cause and effect of economic activities that can affect the environment, social and economy and reduce GHG emissions.

CONCLUSION

Using sustainable financial technology significantly positively affected on GHG emissions, with a significance level of 1%. The sustainable financial technology's contribution to GHG emissions is 24.7845%. The current outcome remains relatively modest due to the prevalence of developing nations within ASEAN, which are still establishing and organising sustainable infrastructure. Consequently, the implementation of sustainable financial technology varies across the region. The results of this study show that as the implementation of sustainable financial technology becomes more widespread in different regions, it will lead to a reduction in GHG. Thus, the bank's contribution to reducing GHG emissions will increase through financial

services and the promotion of sustainability in society in line accordance with ESG objectives will increase.

This study's findings demonstrated that deploying sustainable financial technology positively affected mitigating greenhouse gas emissions. Given the findings, 1). ASEAN countries ought to expedite the adoption of digital technology to reduce greenhouse gas emissions; 2). ASEAN countries should formulate policies and carefully assess the effects of financial inclusion synergies while establishing development plans and strategies for addressing climate change mitigation; 3) ASEAN countries should promote the production of new works to foster a sustainable economy. This can be achieved by allocating research money and providing financial support or technical facilities to areas that need more technological resources; 4) Subsequent studies can investigate the effect of technology-driven financial inclusion on economic growth, corporate finance in financial and non-financial industries, and additional variables that contribute to sustainability, such as legislation.

LIMITATION

The data used in this study covers only a specific period and ASEAN member countries, so the research findings cannot be fully generalized to other regions or longer time frames. The GHG emission data used is sourced from official publications, which may have limitations in terms of accuracy or completeness, particularly in countries where environmental reporting systems are still developing.

REFERENCES

T. Ahmed, S. Mekhilef, R. Shah, and T. Urmee, “Modelling of ASEAN Power Grid Using Publicly Available Data,” in Asia-Pacific Power and Energy Engineering Conference (APPEEC), Dec. 2018, pp. 411–416, doi: 10.1109/APPEEC.2018.8566299.

A. Aljandali and M. Tatahi, Economic and Financial Modelling with EViews: Statistics and Econometrics for Finance, vol. 10377. London, UK: Springer International Publishing AG, 2018, doi: 10.1007/978-3-319-92985-9_1.

Q. Bing-nan, W. Yu, and Z. Hao, “Does Digital Economy Improve Urban Air Quality: Quasi-Natural Experiment Based on National Big Data Comprehensive Pilot Zone,” J. Guangdong Univ. Financ. Econ., vol. 37, no. 1, pp. 58–74, 2022. Accessed: Aug. 02, 2023. [Online]. Available: http://xb.gdufe.edu.cn/en/article/id/137ab003-4ab5-4b22-9396-a367cf20d6f0

K. Chen and S. Zhang, “Influence of Energy-Efficient Infrastructure, Financial Inclusion, and Digitalization on Ecological Sustainability of ASEAN Countries,” Front. Environ. Sci., vol. 10, no. October, pp. 1–12, 2022, doi: 10.3389/fenvs.2022.1019463.

S. Chen, D. Ding, G. Shi, and G. Chen, “Digital Economy, Industrial Structure, and Carbon Emissions: An Empirical Study Based on a Provincial Panel Data Set from China,” Chinese J. Popul. Resour. Environ., vol. 20, no. 4, pp. 316–323, Dec. 2022, doi: 10.1016/j.cjpre.2022.11.002.

S. Dahiya and M. Kumar, “Linkage Between Financial Inclusion and Economic Growth: An Empirical Study of the Emerging Indian Economy,” Vision, vol. 24, no. 2, 2020, doi: 10.1177/0972262920923891.

I. Ghozali and D. Ratmono, Analisis Multivariat dan Ekonometrika: Teori, Konsep, dan Aplikasi dengan EViews 8, 1st ed. Semarang: Badan Penerbit Universitas Diponegoro, 2013. Accessed: Aug. 18, 2023. [Online]. Available: https://scholar.google.co.id/citations?view_op=view_citation&hl=en&user=kbmkIQQAAAAJ&citation_for_view=kbmkIQQAAAAJ:polMJLZb0X8C

Herlina, F. M. Leon, and H. S. Lestari, "The Impact of Green Credit, Green CSR, and Digital Financial Inclusion on Profitability in ASEAN Banks," J. Econ. Manag. Trade, vol. 31, no. 8, pp. 159–171, 2025, doi: 10.9734/jemt/2025/v31i81340.

Herlina, Y. P. D. Sasongko, T. H. Rachmad, and K. G. R. Manuel, "Pengaruh Strategi Komunikasi Manajemen Bisnis Digital terhadap Optimisme Pengusaha UMKM di DKI Jakarta," Interak. J. Ilmu Komun., vol. 12, no. 2, pp. 250–365, 2023, doi: 10.14710/interaksi.12.2.250-365.

Herlina, D. Widyaningrum, and G. Theotista, "Tipologi Financial Technology Paylater: Technology Acceptance Model (TAM)," Formosa J. Multidiscip. Res., vol. 2, no. 1, pp. 207–216, 2023.

Herlina and F. R. Wilujeng, "The Moderating Effect of Bank Size on the Relationship Between Risk and Profitability in ASEAN Banking During the COVID-19 Pandemic," J. Indones. Econ. Res., vol. 3, no. 1, pp. 13–19, 2025.

R. Jatana and H. Jain, "Green Banking and Profitability: An Empirical Study of Indian Commercial Banks," SUMEDHA J. Manag., vol. 9, no. 2, pp. 14–27, Apr. 2020, doi: 10.46454/sumedha/9.2.2020.2.

B. Kiwan and N. S. Kalib, "A Review on the Method for Investigating Carbon Dioxide Emissions in ASEAN," in IOP Conference Series: Earth and Environmental Science, Institute of Physics, 2022, pp. 1–11, doi: 10.1088/1755-1315/1074/1/012012.

M. D. Komala and W. Widodo, "The Nexus Between Financial Inclusion and Monetary Policy: The Case Study of Selected ASEAN Countries," J. Econ. Bus. Account. Ventur., vol. 25, no. 1, p. 123, 2022, doi: 10.14414/jebav.v25i1.2920.

V. B. Kusnandar, "Persentase Masyarakat di Asia Tenggara yang Belum Tersentuh Layanan Perbankan," Databoks. Accessed: Aug. 03, 2023. [Online]. Available: https://databoks.katadata.co.id/

T. Lei, X. Luo, J. Jiang, and K. Zou, "Emission Reduction Effect of Digital Finance: Evidence from China," Environ. Sci. Pollut. Res., vol. 30, pp. 62032–62050, 2023.

T. M. S. Mulyana and Herlina, "Evenly Brightening Using Kurtosis Gaussian Pattern to Simplify Image Binarization," J. Phys. Conf. Ser., vol. 1397, no. 1, 2019, doi: 10.1088/1742-6596/1397/1/012076.

S. Nan and X. Luo, "Assessing the Role of the Digital Economy on Carbon Emissions: New Evidence Based on the Spatial Durbin Model," in Proceedings of the International Scientific Conference Hradec Economic Days 2023, University of Hradec Kralove, Apr. 2023, pp. 482–493, doi: 10.36689/uhk/hed/2023-01-046.

H. B. Ong, S. Wasiuzzaman, L. L. Chong, and S. W. Choon, "Digitalisation and Financial Inclusion of Lower Middle-Income ASEAN," Heliyon, vol. 9, no. 2, 2023, doi: 10.1016/j.heliyon.2023.e13347.

I. Overland et al., "The ASEAN Climate and Energy Paradox," Energy Clim. Chang., vol. 2, pp. 1–10, Dec. 2021, doi: 10.1016/j.egycc.2020.100019.

W. Perwithosuci, H. Z. Hadibasyir, and M. Arif, "Carbon Emissions and Urbanization in ASEAN-5 Countries," Optim. J. Ekon. dan Pembang., vol. 12, no. 2, pp. 203–212, Mar. 2023, doi: 10.12928/optimum.v12i2.6582.

P. Ponce and S. A. R. Khan, "A Causal Link Between Renewable Energy, Energy Efficiency, Property Rights, and CO2 Emissions in Developed Countries: A Road Map for Environmental Sustainability," Environ. Sci. Pollut. Res., vol. 28, no. 28, pp. 37804–37817, 2021, doi: 10.1007/s11356-021-12465-0.

V. Pramaningsih, K. Dewi, and A. S. Ediansjah, "Prediction of Carbon Dioxide Emission from Electricity Generation in ASEAN," Indones. J. Urban Environ. Technol., vol. 6, no. 1, pp. 20–35, Jul. 2022, doi: 10.25105/urbanenvirotech.v5i3.12838.

X. Qin, H. Wu, and R. Li, "Digital Finance and Household Carbon Emissions in China," China Econ. Rev., vol. 76, Dec. 2022, doi: 10.1016/j.chieco.2022.101872.

N. Renzhi and Y. J. Baek, "Can Financial Inclusion Be an Effective Mitigation Measure? Evidence from Panel Data Analysis of the Environmental Kuznets Curve," Financ. Res. Lett., vol. 37, p. 101725, 2020, doi: 10.1016/j.frl.2020.101725.

D. Rongrong and Z. Aoxiang, "The Impact of Urban Digital Finance Development on Carbon Emission Performance in China and Mechanism," Resour. Sci., vol. 43, no. 11, pp. 2316–2330, 2021, doi: 10.18402/resci.2021.11.14.

H. F. Sagbakken, M. Merdekawati, I. Overland, H.-Y. Chan, B. Suryadi, and R. Vakulchuk, "Climate Change, Security and Regional Cooperation in ASEAN," ASEAN Fokus, vol. 14, no. 1, pp. 1–3, 2020. [Online]. Available: https://www.researchgate.net/publication/340249974

P. Schueffel, "Taming the Beast: A Scientific Definition of Fintech," J. Innov. Manag., vol. 4, pp. 32–54, 2016. [Online]. Available: http://www.open-jim.org

L. Shao and J. Chen, "Digital Finance and Regional Green Innovation: The Perspective of Environmental Regulation," Environ. Sci. Pollut. Res., 2023, doi: 10.1007/s11356-023-28356-5.

Y. Singh, "Environmental Management Through Green Banking: A Study of Commercial Banks in India," 2015. [Online]. Available: http://www.ijims.com

S.-H. Tan, M. Hong, and T. H. Chan, "Economic Growth, Urbanisation and Carbon Emissions: Evidence from Selected ASEAN Countries," Int. J. Ind. Manag., vol. 6, no. 1, pp. 9–16, Jun. 2020, doi: 10.15282/ijim.6.0.2020.5637.

N. Thangaiyarkarasi and S. Vanitha, "The Impact of Financial Development on Decarbonization Factors of Carbon Emissions: A Global Perspective," Int. J. Energy Econ. Policy, vol. 11, no. 6, pp. 353–364, 2021, doi: 10.32479/ijeep.11872.

M. Triani, H. B. Tambunan, K. Dewi, and A. S. Ediansjah, "Review on Greenhouse Gases Emission in the Association of Southeast Asian Nations (ASEAN) Countries," Energies, vol. 16, no. 9, May 2023, doi: 10.3390/en16093920.

V. Venkatesh, J. Y. L. Thong, and X. Xu, "Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead," J. Assoc. Inf. Syst., vol. 17, no. 5, 2016.

H. Wen, J. Yue, J. Li, X. Xiu, and S. Zhong, "Can Digital Finance Reduce Industrial Pollution? New Evidence from 260 Cities in China," PLoS One, vol. 17, no. 4, Apr. 2022, doi: 10.1371/journal.pone.0266564.

B. Yang, "China's Low-Carbon Economy Development and Carbon Finance Market Supervision Mechanism," Low Carbon Econ., vol. 8, no. 4, pp. 97–105, 2017, doi: 10.4236/lce.2017.84008.

Z. Yang, L. Fu, and Y. Chen, "Digital Economy and Pollution Reduction: Mechanism and Regional Heterogeneity," PLoS One, vol. 18, no. 2, Feb. 2023, doi: 10.1371/journal.pone.0277852.

X. Zhou, "The Impact of Digital Finance Development on CO2 Emissions in China," Low Carbon Econ., vol. 13, no. 3, pp. 113–126, 2022, doi: 10.4236/lce.2022.133006.

L. Zuo, H. Li, and X. Xia, "An Empirical Analysis of the Impact of Digital Finance on the Efficiency of Commercial Banks," Sustainability, vol. 15, no. 5, Mar. 2023, doi: 10.3390/su15054667.