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FINANCIAL STABILITY, INNOVATION AND GREEN DEVELOPMENT

Estabilidade financeira, inovação e desenvolvimento verde

Muhammad Naveed Jamil, Abdul Rasheed
Institute of Business Administration, Khwaja Fareed University of Engineering and Information Technology
Rahim Yar Khan, Pakistan
Email: mnaveedknp@gmail.com, abdul.rasheed@kfueit.edu.pk

ABSTRACT

Eco-efficiency is a biggest universal challenge and one-fourth CO_2 emission produce by World Transport sector. The main objective to examines the effect of External finance and Transport Power Diversity on Eco-efficiency and identify best finance and transport eco-power source. This study used two ways of data analysis; first, past and future trend analysis, and second, Regression, GMM and Robust measurement; first, External finance Trend of four countries, Japan has least dependent country, china only face dependency in FDI, while Pakistan major dependency on Remittances and ODA-Foreign-Aid. Fuel Consumption Trend; Japan Eco-efficiency policy is better than other three countries. Second; Regression and GMM results indicates external finance i.e. FDI, Remittances, ODA and Transport Power Source i.e. Oil and Electric 1% high significant impact on eco-efficiency, SDGs, GDP highly significant inverse, health negative and Per-Capita GDP, Government Consumption positive relationships exist with Eco-efficiency and robust test validate the results. Study suggested external finance modern finance source for technology enhancement and economy. Transport Cargo-system need to be design according eco-friendly.

Keywords: Financing Stability, Innovation; Green Development; De-carbonization pathways; Central Asia Future Sustainability

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ESTABILIDADE FINANCEIRA, INOVAÇÃO E DESENVOLVIMENTO VERDE

Financial stability, innovation and green development

Muhammad Naveed Jamil, Abdul Rasheed
Institute of Business Administration, Khwaja Fareed University of Engineering and Information Technology
Rahim Yar Khan, Pakistan
Email: mnaveedknp@gmail.com, abdul.rasheed@kfueit.edu.pk

RESUMO

A ecoeficiência é o maior desafio universal e um quarto das emissões de CO_2 produzidas pelo setor de Transporte Global. O principal objetivo é examinar o efeito do financiamento externo e da diversidade energética dos transportes na ecoeficiência e identificar a melhor fonte de energia verde para o financiamento e os transportes. Este estudo utilizou duas formas de análise dos dados; primeiro, análise de tendências passadas e futuras, e segundo, regressão, GMM e medição robusta; Em primeiro lugar, a tendência de financiamento externo em quatro países, o Japão é o país menos dependente, a China só enfrenta dependência do IDE, enquanto o Paquistão tem alta dependência de remessas e ODA-Ajuda Externa. Tendência de consumo de combustível: a política de ecoeficiência do Japão é melhor do que a dos outros três países. Em segundo lugar, os resultados de regressão e GMM indicam financiamento externo, ou seja, IDE, Remessas, APD e Fonte de Energia de Transporte, ou seja, Petróleo e Eletricidade 1% de impacto significativo na ecoeficiência, ODS, PIB inverso altamente significativo, saúde negativa e PIB per capita, Consumo do Governo apresenta relações positivas com Ecoeficiência e testes robustos validam os resultados. O estudo sugeriu o financiamento externo, uma fonte de financiamento moderna para o aprimoramento da tecnologia e da economia. O sistema de transporte de cargas precisa ser projetado de acordo com o eco-friendly.

Palavras-chave: Estabilidade Financeira, Inovação; Desenvolvimento Verde; Vias de descarbonização; Sustentabilidade do Futuro da Ásia Central

INTRODUCTION

Eco-efficiency most significant for human and development embodies aspects of both approaches of environmental efficiency and economic development efficiency. Define Eco-efficiency to resource effectively used, create product and provide better services that meet the human needs (Lupan & Cozorici, 2015). Greenhouse gases is a biggest challenges and one fourth of World Transport sector produce CO_2 emission, all sectors going to reduce CO_2 emission, transportation sector need to Transport Power Generation Diversity (Kjellén & Tasala Gradin, 2020; Momber, 2015). In sharply, automotive technology must be able to achieve the highest CO_2 reduce potential and meet the UN Climate agreement. Paris agreement on climate 2015 was most successful agreement between the advancing global world to set a target to meet eco-environment efficiency and reduce CO_2 emission (L. A. Greene, 2000; Harrould-Kolieb, 2019; Naylor & Ford, 2023; Obergassel et al., 2015; Smith et al., 2015). External finance inflow significantly influences environmental Quality due to the utilization of advanced technology that reduces CO_2 emission (Ayamba, Haibo, Abdul-Rahaman, Serwaa, & Osei-Agyemang, 2020). Despite the fact transport was pivotal in world economy and a global supply chain. Transport vehicle, cargo carriage, ships and ports are blood line for every economy (Notteboom, van der Lugt, van Saase, Sel, & Neyens, 2020). Transport fossil fuel generate anthropogenic emissions and environmental externalities of air pollutant, greenhouse gas emissions and public health (Höök & Tang, 2013; Lelieveld et al., 2019). Transport power system diversity and associated financial costs incurred for EU and Central Asia in order to meet the de-carbonization targets as road map 2050 (Burchart-Korol, Pustejovska, Blaut, Jursova, & Korol, 2018; Knopf et al., 2013; Pang, Mörtberg, & Brown, 2014; Schwanitz, 2013).

The 80 % GHG emissions reduction target for 2050, there for energy-economy models commonly used worldwide I.e. Primes, Green-X, Gains, GEM-E3, NEMESIS, Times-Pan-EU, and World Scan for assessment of world transport energy and climate. In alternative de-carbonization pathways was technological efficiency with different strategies mode, energy system, financial cost and future sustainability of macro-economic implication (Dong & Zhang, 2023; Knopf et al., 2013; Williams et al., 2012; Christopher Yang, McCollum, McCarthy, & Leighty, 2009). Shipping's mission up to 17 % rose if eco-environmental measure not taken (Alamoush, Ölçer, & Ballini, 2022; Bouman, Lindstad, Rialland, & Strømman, 2017; Cames, Graichen, Siemons, & Cook, 2015). An important milestone achieve by adoption of eco-friendly GHG emission, policy of 50% reduction in CO_2 emission till 2050 announced at 72nd Marine environment protection committee meeting help in April 2018, which was the extension pathway of Paris agreement CO_2 emission reduction (Psaraftis & Kontovas, 2020a, 2020b). Transport De-carbonization initiate strategy (Doelle & Chircop, 2019; Earsom & Delreux, 2021). Electrical energy, hydrogen, fuels and renewable fuels was collectively use transport energy sources (X. Chen et al., 2023; Dorotić et al., 2019; Jorgensen, 2008; Kraciuk, Kacperska, Łukasiewicz, & Pietrzak, 2022). The Eco-friendly CO_2 emission challenge can be met through appropriate technology mix (Hren et al., 2023; Lewis, Kelly, & Keoleian, 2014; Orsi, Muratori, Rocco, Colombo, & Rizzoni, 2016).

The External finance, technology valued for Eco-efficiency and sustainable development, Neo classical growth-theory, and endogenous growth-theory (Ramanayake, 2019; Solow, 1956) best fit for this study model. Theories component of dynamic input of capital flow, labour and technology, the main output of consumption and population behaviour, are valuable indicators influencing results. Classical Growth Theory: Capital growth becomes Economic Development at the nature rate while equal to population growth, with inventions excluded (Little, 1957; Michl & Tavani, 2020, 2022; Saeed, 2021). Endogenous Growth Theory: was an extension of neo-classical growth theory. Endogenous growth theory indicates that population growth, human capital, and investment knowledge enhance economic Development. Better work within the system and basic aim of theory difference in wealth developing and developed countries if investment in infrastructure (physical capital) will returns diminishing (Chandra, 2022a, 2022b; Mankiw, Romer, & Weil, 1992). Therefore external finance and advance technology in transportation sector benefit for eco-efficiency. Research Gap is to describe the External finance and transport power diversity i.e. Oil, Gas and Electric, and identify best transport eco-energy generation and financial source that meets the Paris CO_2 emission reduction agreement. Empirically technological transportation system increase eco-environment efficiency and sustainability, De-growth air transportation pathway of economic growth (Köves & Bajmócy, 2022). In Modern Technology and electric mobility used to supply electric motors to provide totally or partially produce power for transportation with CO_2 emission reduction (Delgado,

Moura, & de Almeida, 2021). Transport CO_2 emission increased almost 80 % from 1990 to 2019, which is serious challenge for world eco-efficiency target. Revise growth and energy utilization source in transport sector to mitigate transport emissions (Dai, Alvarado, Ali, Ahmed, & Meo, 2023).

To meet the SDGs Agenda-2030, we needed considerable financing-effort from the government sector of Gov. Consumption and Health-Exp; study added government expenditure and predicted a positive association between Sustainable developments. The above variable Gov. Consumption and Health-Exp analyses will show the influence on Eco-efficiency and Economic Development (Aust, Morais, & Pinto, 2020; Malikane & Chitambara, 2017). This study inspires the above motivation and developed aims to cross region investigate, the main objective of this study is to examine the effect of external finance and Transport Power Diversity i.e. Oil, Gas and Electric on CO_2 emission reduction and identify best eco-power energy Generation. Moreover, empirical literature further may elaborate; challenges, external finance, transport energy source, world eco-efficiency target and revise growth.

1 LITERATURE REVIEW

The experience of countries has shown that international emission trading was a cost effective way to reduce global Transport CO_2 emission. Emissions charges were an effective way for the Government to intervene in order to environmental protection (Burchell, Ison, Enoch, & Budd, 2019; Camporeale, Caggiani, Fonzone, & Ottomanelli, 2019; Carbone, Helm, & Rutherford, 2009; Fujimori et al., 2016; Fujimori, Masui, & Matsuoka, 2015; Gomez & Vassallo, 2020; H. Wang, Shi, Xue, He, & Liu, 2022; X. Zhang, Qi, Ou, & Zhang, 2017). External finance has positive association of energy consumption. Foreign direct investment enhance economic development, Eco-efficiency Kuznets curve and external finance contribute inward SDGs (Bekun, Adedoyin, Lorente, & Driha, 2022). external finance increase the energy consumption and efficiency (Zakari, Khan, Tan, Alvarado, & Dagar, 2022). Energy consumption decline when Co_2 emission increased (Zafar, Qin, & Zaidi, 2020). Road Environment link with takes advantage of marginal cost across regions and capital allocation toward low cost efficiency for emission reduction, Government, market forces role was significant for investment and promote emissions reductions (Böhringer & Welsch, 2004; Hu, Qi, & Chen, 2023; Li, Gao, Hu, Jia, & Wang, 2023; Qi & Weng, 2016; Wu, Peng, & Lao, 2023). Most existing literatures on economic development have used the Gross Domestic products as the chief indicator of economic development (Ijirshar, 2019). Financial shocks generated economic fluctuations, external financial frictions might increase the severity of economy (Balcilar, Ozdemir, Ozdemir, Aygun, & Wohar, 2022; Zetlin-Jones & Shourideh, 2017). Government investment is general government final consumption expenditure (GOVEXP) as a share to GDP. Gov.-Consumption defines the final consumption expenditure of the general government as the percentage of the GDP. Health Exp is the domestic health expenditure of the general government as the percentage of the total expenditure of the general government (Aisen and Veiga, 2011).

The combination of Financial Resources, Transport environmental and economic policies can reduce the economic failure and disappointment. Effective uses of environmental resource through low cost economic and transportation means, road congestion pricing, parking levies and mitigate traffic congestion (Maruyama & Sumalee, 2007; Perkins, Wagner, & Leung, 2018; G. Santos, 2004). Modern transport system and Sustainable Development Goals toward achieved economic success (Harichandan, Kar, Bansal, & Mishra, 2023; Naumov, Keith, & Sterman, 2023; Rony et al., 2023; Weng, Ma, Xie, & Cheng, 2022; Xing, Udemba, Tosun, Abdallah, & Boukhris, 2023). Global climate success is based on China and U.S corporation annual CO_2 emission, As part of Paris agreement both nations of China and U.S has set targets reduce CO_2 emission almost 50% by U.S 2005 to 2030 and China has on peak industrial and transportation CO_2 emission commitments to achieve CO_2 emission neutrality by 2060 that association Asian Region of Japan, India and Pakistan (Agency, 2009; Z. Deng et al., 2022; Herman, 2022; M. Khan & Northrop, 2022).

The main challenge was to achieve environment, viable recovery and transportation of unconventional Oil. Oil companies have great concerned in unconventional oil as alternative resource of energy supply (R. Santos, Loh, Bannwart, & Trevisan, 2014). Crude Oil pipelining might require hybrid technology, reduce cost and transportations (Martínez-Palou et al., 2011). Different type of fuels can derive i.e. biodiesel and hydro processing technique. Biodiesel enhance emission and hydro process technique was useful renewable diesel production, performance and CO_2 emission reduction (Sonthalia & Kumar, 2019). A UK based study indicates Transport Oil

demand was depend on income and where price estimate fuel efficiency was considerable factor. CO_2 emission policies base transport efficiency, future energy demand and environment implication (Broadstock & Hunt, 2010). Oil productions in order to adopt dynamic carbon tank emissions factor in companies (S. Greene, Jia, & Rubio-Domingo, 2020). De-carbonization potentials in transportation (L. Wang, Xue, Zhao, Wang, & Zeng, 2020).

Oil reservoirs may adverse factor and CO_2 Gas emission with great sweep efficiency (Etemad, Kantzas, & Bryant, 2020). De-carbonization potentials in transportation (L. Wang et al., 2020). Empirical investigation on natural gas vehicles, vehicle market, and success-failure factor indications for twelve countries deploy of natural gas vehicle is more efficient (M. I. Khan, 2017). Nineties FCA has invested in CNG power vehicles and its becoming leader one of them transportation system. Road transport vehicles still power on natural Gas of 65%, while a progressive increase of battery electric hybrids vehicles. Natural Gas modern technology is mandatory to achieve high efficiency by removing conventional fuels usage (Ferrera, 2017). Natural gas significant for transport power fuel are emission performance, safety and economic. CNG has several advantages over transport power with gasoline fuel and diesel oil, considerable cost and emission reductions (M. I. Khan, Yasmin, & Shakoor, 2015). Natural Gas was Optimization problems in transport power and transmission system problem was quite extensive (Ríos-Mercado & Borraz-Sánchez, 2015). Transportation de-carbonization was a complex problem involving environment, population, technology and economy. Operation pathway systematic methods were helping to transportation sustainability. CO_2 emission reduction, hybrid system was exploring the transportation optimizations de-carbonization ability (L. Wang, Zhao, Wang, & Xue, 2021).

Electric vehicles modernizations pose great potentials toward de-carbonization of transportation sector. Plug-in hybrid electric transport power system was promising pathway to reduce greenhouse gas emission (Blumsack, Samaras, & Hines, 2008). Plug-in hybrid and battery electric transport power can achieve 50% energy benefit compare to other of mode of transport power. While Transport CO_2 emission results can be vary based on time and location of electric power generation. Therefore, transport power through electric is benefits of promoting electric vehicles (Y. Chen et al., 2018). CO_2 emission increase due to electric transport vehicle, a study based China, U.S and EU indication plug-in electric transport power vehicle was harmful the CO_2 emission and sold electric vehicle and produce CO_2 emission 1 million tons in 2012 to 2025 and trending 671, 280, 143 million tons in 2050 respectively in those three markets (Gan, Wang, Lu, & Kelly, 2021). Expansion of conventional transportation was accelerates the pollution (CO_2 emission) and extends the demand of green transportation. Eminence of electric transport power vehicles was a future of electric Cars and other transportation system. This uses a bi-directional power- flow of EVs battery charging may it charge the car or either sustain the utility grid (Ismail et al., 2022). Large scale use of electric power transportation is reduce CO_2 emission and mortality of passenger (Pan et al., 2023). India was on tradition fossil emission way with heavy population but few years its policies change to de-carbonization in transportation sector and set electric power transport goal by 2030 (P. Pradhan, 2021; Raugei & Winfield, 2019).

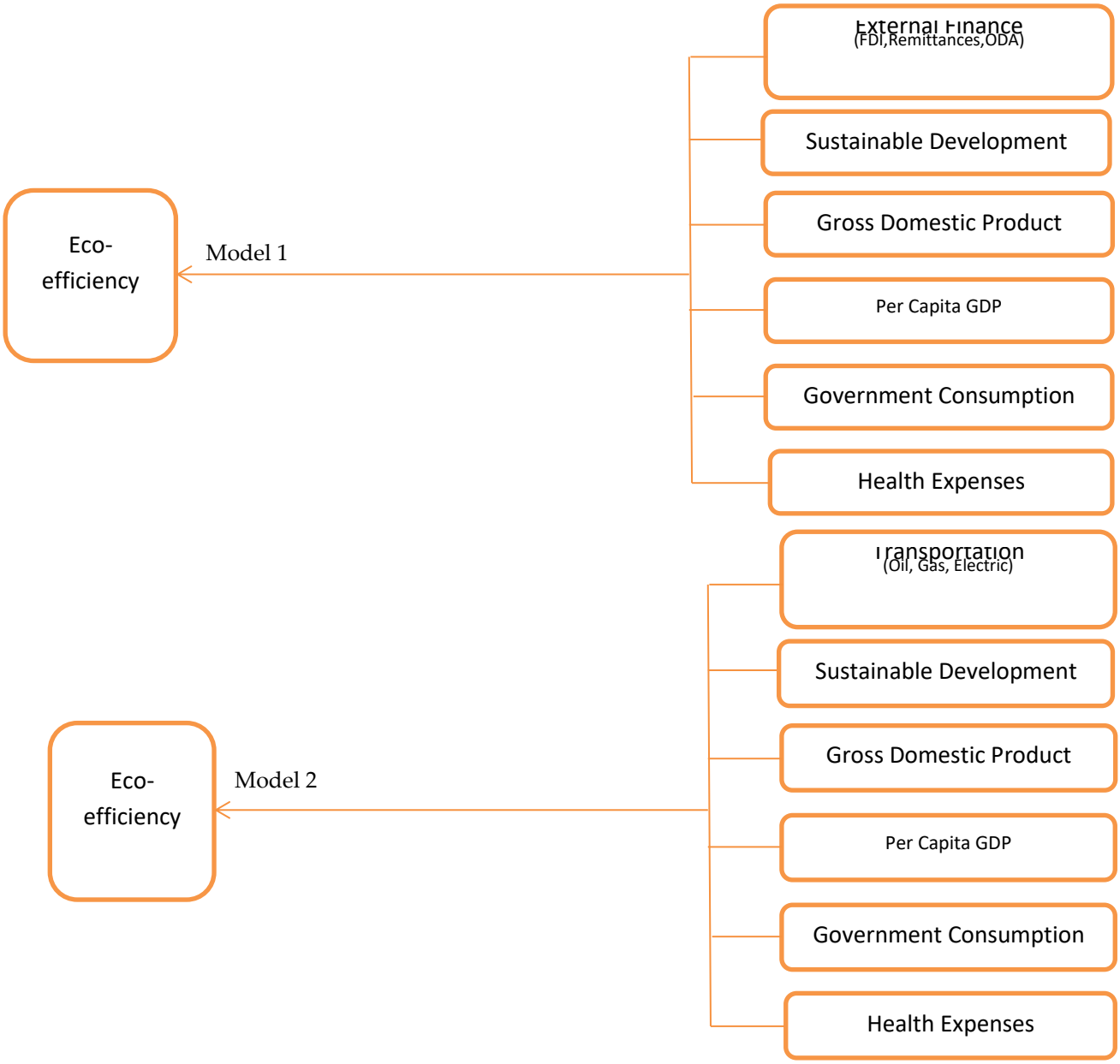
The global transport sector has become aware of the environmental consequences but grappling with Development and Eco-efficient agenda. Only appeals to environmental Sustainability and carbon footprint reduction are not likely to change through user behaviour-required a mechanism, Foreign financing, sustainable mobility and comprehensive champions (Uteng, 1997). In long-run, FDI has not affected the intensity of CO_2 emissions, while economic Development increases the intensity of CO_2 emissions. In the short run, no effects were indicated between FDI, Eco-efficiency and economic development (Shaari, Hussain, Abdullah, & Kamil, 2014). External finance inflow contributes to unpolluted Eco-efficiency and economic growth (Lee, 2013). Foreign finance useful in CO_2 emissions reduction in central and western regions of china; Green technology may enhance Eco-friendly efficiency (C. Zhang & Zhou, 2016). Foreign Direct Investment enhances Carbon Dioxide emissions due to more industrialization. At the same time, technological Development causes Eco-efficiency (Farooq, 2022).

According Migration and development World Bank report remittance send to low and middle income countries enhance economy. Important factor, a massive number of remittances go into investment (Sapkota, 2013). Another importance of remittances migrant worker sends money in shape of US Dollar, euro, pound, Yen and other major currencies. These remittances meet the need of countries foreign reserves, resolve the balance of payment issues, countries able to enhance modern technology (Esteves & Khoudour-Castéras, 2009; Jayasekara, 2022; A. Pradhan, Afrin, & Islam, 2012).

Net official development assistance (ODA) consists of disbursements of loans, assistance and grants by official agencies for promote economic development and welfare of countries. External finance inflows with clean technological transfer and assistance improvement in labour and environmental management practices will help developing countries to achieve the sustainable development goals. Mitigation of greenhouse gas emissions depends on enhanced energy efficiency, adoption of clean and modern energy technologies, such as renewable energy, nuclear, and the utilization of carbon capture and storage for fossil fuel and biomass energy generation processes (Sarkodie & Strezov, 2019).

Greenhouse gases is a biggest challenges of our age and one fourth of World Transport sector produce CO_2 emission, almost all sectors going to reduce fossil dependency, but transport sector still base on fossil dependency. Government need to enacting policies to encourage foreigners to finance eco-projects and people move away from gasoline and diesel transportation. Electric power may have alternative of fossil power generation toward CO_2 emission reduction (Kjellén & Tasala Gradin, 2020; Momber, 2015).

Figure 1 - Two complementary Eco-efficiency Models



2 MATERIALS AND METHODS

2.1 Research Method

The study to examine the effect of External Finance and Transport Power Diversity on Eco-efficiency; De-carbonization pathways for central Asia future sustainability: Evidence from Asian Regions Countries. This study is to develop an Environment measure and examine the effect of the Asian four Countries of Japan, China, India and Pakistan. Time series data is collected since 2000 to 2021 from World Bank, IMF and other transport reports.

2.2 Calculation of External finance and Eco-Efficiency

$$\text{Eco. efficiency}_i = \beta_0 + \beta_1 EF_i + \beta_2 SDGs_i + \beta_3 GDP_i + \beta_4 P.GDP_i + \beta_5 GOVCONS_i + \beta_6 HEALTHEXP_i + \varepsilon \ldots.1$$

The above equation i denoted to the Asian Country of Japan, China, India and Pakistan, and Eco-efficiency~ CO_2 emission per capita; Carbon dioxide emissions stem from burning fossil-fuels and manufacturing and divided by GDP per capita (Belucio & Guarini, 2023; Ginez & Tabag, 2023; Sarkodie & Strezov, 2019)., EF ~ external finance (FDI, Remittance, and ODA-Foreign Aid) is the natal logarithm of the average inflow of external finance. Although the majority of empirical literature considers external finance appropriate to Sustainable Progress and we foresee and consider as the "positive-coefficient" for the variable EF (b1>0) (Mainali, Luukkanen, Silveira, & Kaivo-oja, 2018; Sarkodie & Strezov, 2019). SDGs refer to region countries average ranking scores. GDP ~ refer for Domestic Annual Growth and P.GDP ~ for Per Capita GDP. Gov. Consumption determines a country's final consumption expenditure (GDP %), and Health-Exp is the domestic-health expenses (Total expenses %) of a country. To meet the Eco-efficiency Agenda-2030, we needed considerable financing-effort from the government sector, and we added government expenditure and predicted a positive association between Eco-efficiency (Malikane & Chitambara, 2017).

2.3 Calculation of Transport Power CO_2 emission and Eco-efficiency

Transport CO_2 emission is measure through % of total fuel combustion by transport. It covers all combustion of fuel by all means of transport; road, rail and pipeline transport except international marine bunkers and international aviation. Transport Oil Power CO_2 emission is measure through % of total Oil fuel consumption (kt) in transport sector. In simple word we can say transport power produce through crude oil and petroleum products. Transport Gas Power CO_2 emission is measure through % of total gaseous fuel consumption (kt) in transport sector. CO_2 emissions through liquid fuel consumption mean it mainly focus natural gas use by transport power as energy source. Transport Electric Power CO_2 emission is measure through % of total Electricity consumption (kWh) in transport sector. Electric Power consumption mean total utilized electricity at transport sector; plants, manufacturing, heating, coaling and charging of batteries of different transport mode. Transport Eco-efficiency is measure through Air Pollution = Environment Cost / Economic output ~ Transport Air Pollution ~ CO_2 emission from transport (% of total) / transport GDP share (% of total GDP). This study examines effect of External Finance and Transport CO_2 emission on Eco-efficiency through Regression and GMM for panel and Robustness used for sustainability and validity the effect. Transport CO_2 emission factor equations as

$$\text{Tranport Eco efficiency}_t = f(C_{it}, S_{it}, Y_{it}, P_{it}, G_{it}, H_{it}) \sim \ldots\ldots\ldots..2$$

$$\text{Transport Eco efficiency}_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 S_{it} + \beta_3 Y_{it} + \beta_4 P_{it} + \beta_5 G_{it} + \beta_6 H_{it} + \varepsilon \ldots\ldots\ldots\ldots\ldots3$$

The above equation $_i$ denotes to the Asian four Countries of Japan, China, India and Pakistan, and $_t$ for time, Eco-efficiency~ CO_2 emission per capita, C for Transport fuel consumption, I.e. Transport Oil Power, Transport Gas Power, and Electric Power, S for SDGs refer to region countries average ranking scores, Y for GDP Annual Growth and P for Per Capita GDP. G determines a country's final consumption expenditure (GDP %), and H is the domestic-health expenses (Total expenses %) of a country. Although the majority of empirical literature was considers "positive-coefficient" for the variable EE (b1>0) (Mainali et al., 2018; Sarkodie & Strezov, 2019).

$$P(\text{Trend}_i > j) = g(X_i\beta j) = \frac{\exp(aj + X_i\beta j)}{1 + \exp(aj + X_i\beta j)} \quad j = 0,1,2,3,4 \ldots\ldots4$$

In which $_i$ denotes to the Asian four Countries of Japan, China, India and Pakistan and X_i using an equation, is a vector of a predictor of variables and describe as Air Pollution, Transport Fuel consumption Power, Transport Oil Power, Transport Gas Power, and Electric Power. Country performance trends measured through ordinal variables between 0 and 40 indicate place and positions toward trend of Transport CO_2 emission (Anyanwu & Yameogo, 2015).

3 RESULTS

Table 1 - Descriptive Statistic

	FDI	Remittance	ODA	ECO	SDGs	Transport	Electric	Gas	Oil	GDP	GDP.PC	GFC	Health
Mean	1.53	2.18	0.41	4.16	63.86	15.06	0.03	1.00	2.33	4.45	3.40	13.83	5.00
Median	1.10	0.83	0.19	2.15	61.91	11.85	0.01	0.75	2.33	4.78	3.08	13.29	4.02
Maximum	4.55	8.99	2.52	9.91	79.56	28.93	0.09	2.78	3.31	14.23	13.64	21.42	10.99
Minimum	-0.05	0.02	-0.01	0.62	51.60	4.10	0.00	0.28	1.49	-7.30	-8.20	7.35	2.14
Std. Dev.	1.28	2.41	0.55	3.60	9.68	7.50	0.03	0.65	0.56	4.19	4.10	3.86	2.72

Table 1 Descriptive statistic of four Asian countries of Japan, China, India and Pakistan indicating the potential of each variable able to impact on Eco-efficiency. Model 1 of external finance variable able to potential impact on eco-efficiency; mean of remittance 2.18, FDI 1.53, ODA 0.41 and Standard deviation 2.41, 1.28,0.55 respective able to influence on eco-efficiency. Model 2 of transport Power diversity variable able to potential impact on eco-efficiency; the mean of Transport 15.06 and standard deviation 7.50 showing highest potential impacting factor for Eco-efficiency, The mean of Oil 2.33 and standard deviation 0.56 at 2nd and, Gas mean 1.00 and standard deviation 0.65 on 3rd major power source. Electric power source is on 4rth place with increasing share in specified regions. Eco-efficiency powers of mean of 4.16 and standard deviation 3.60 as dependent variable; meanwhile control variables means and standard deviation of SDGs 63.86, 9.68, GDP Per Capita Growth 3.40 and 4.10 and GDP 4.45 and 4.19 respectively potentially able to affect Eco-efficiency.

Table 2 - Descriptive Average Trend of Four Countries

Country Description	External Finance Trend			Fuel Consumption Trend			
	FDI	Remittance	ODA & Foreign Aid	Transport CO2 emission	CO2 intensity Oil Transport	CO2 intensity GAS Transport	Electricity Transport
China	3.047	0.193	0.031	3.550	3.090	1.020	0.020
India	1.613	3.157	0.160	5.310	2.220	0.590	0.010
Japan	0.320	0.049	0.220	8.170	2.410	1.750	0.080
Pakistan	1.140	5.310	1.220	11.890	1.600	0.620	0.004

Table 2 Descriptive Average Trend of four Asian countries of Japan, China, India and Pakistan indicating the external finance dependency of each variable and Transport energy usage CO_2 emission intensity. On average External finance Trend of 4 countries, China FDI is 50%, India 26%, Pakistan 19% and Japan 5% indication of external finance~ FDI dependency. In Remittances dependency, Pakistan on top with 61%, India on second with 36%, China share is 2% and Japan with 1%. In ODA and Foreign Aid utilization dependency, Pakistan on top with 75%, Japan with 13%, India with 10% and China with 2%. Trend of external finance of 4 countries, china only face dependence in FDI, while Pakistan major dependency on Remittances and ODA-Foreign Aid indication for policy maker. On average Fuel Consumption Trend of 4 countries, Pakistan fuel consumption is 41%, Japan 28%, India 19% and China 12% indication of Transport CO_2 emission ~ transportation fuel consumption. In Oil transport consumption China on top with 33%, Japan on second with 26%, Indian oil share is 24% and Pakistan with 17%. While Gas utilization japan on top with 44%, china at second with 26%, India and Pakistan equally with 15%. In

electric transportation Japan on top with 70%, China with 18%, India with 9% and Pakistan with 3% electric power using nations. Japan Air Pollution policy is better than other three countries with sustain Air Pollution.

Table 3 - External Finance Diversity impact on Eco-efficiency (Regression)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	-0.513276	0.113972	-4.503536	0.0000
REMITTANCES	-0.319654	0.079464	-4.022611	0.0001
ODA	0.894965	0.268436	3.334003	0.0013
SDGs	0.114421	0.022814	5.015266	0.0000
GDP	-2.212982	0.294696	-7.509369	0.0000
GDP_PC	2.212158	0.306196	7.224648	0.0000
GC	0.060173	0.112992	0.532545	0.5958
HEALTH	-0.105123	0.111754	-0.940660	0.3497
R-squared	0.947352	Mean dependent var		4.159784
Adjusted R-squared	0.942745	S.D. dependent var		3.603880
S.E. of regression	0.862334	Akaike info criterion		2.628161
Sum squared resid	59.48966	Schwarz criterion		2.853373
Log likelihood	-107.6391	Hannan-Quinn criter.		2.718893
Durbin-Watson stat	0.327518			

01% *** 05% ** 10%

Table 3 is showing the Regression least square method measurement results that indicate the external finance (FDI, Remittances, ODA) of four Asian countries of Japan, China, India and Pakistan effect on eco-efficiency. FDI -0.513276***, Remittances -0.319654*** and ODA 0.894965*** indicates 1% high significant impact on eco-efficiency. Control variables Sustainable development Goal of UN-Target 2050 is 0.114421***, GDP -2.212982*** and GDP per Capita 2.212158*** highly 1% significant, while Government Consumption 0.060173 and Health -0.105123 less impact on eco-efficiency. Conclude results as External finance is an important factor for Eco-efficiency that enhances the efficiency and performance.

Table 4 - Transport Power Diversity impact on Eco-efficiency (Regression)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TRANSPORT	0.016816	0.025053	0.671214	0.5040
OIL	2.291111	0.473227	4.841467	0.0000
GAS	0.186995	0.187000	0.999972	0.3204
ELECTRIC	135.6866	13.83665	9.806322	0.0000
SDGs	-0.082610	0.031298	-2.639491	0.0100
GDP	0.044549	0.343425	0.129720	0.8971
GDP_PC	0.001623	0.343044	0.004732	0.9962
GC	0.138707	0.077385	1.792439	0.0769
HEALTH	-0.439809	0.105482	-4.169503	0.0001
R-squared	0.974263	Mean dependent var		4.159784
Adjusted R-squared	0.971656	S.D. dependent var		3.603880
S.E. of regression	0.606733	Akaike info criterion		1.935201
Sum squared resid	29.08187	Schwarz criterion		2.188565
Log likelihood	-76.14882	Hannan-Quinn criter.		2.037275
Durbin-Watson stat	0.342707			

01% *** 05% ** 10%

Table 4 is showing the Regression least square method measurement results that indicate the Transport Power Diversity (Oil, Gas, Electric) of four Asian countries of Japan, China, India and Pakistan effect on Eco-efficiency. Overall transport power 0.016816, Oil transport power 2.291111***, Gas 0.186995 and Electric power 135.6866*** indicating significance and important for Eco-efficiency, meanwhile Oil and Electric power diversity results showing 1% highly significant impact on eco-efficiency. Control variable of Sustainable development Goal of UN-Target 2050 is -0.082610*** and Health -0.439809*** highly significant impact on Eco-efficiency. Meanwhile GDP, GDP Per Capita and Government Consumption less impact factor for eco-efficiency. Conclude results as Transport energy diversity is an important for Eco-efficiency, meanwhile Oil and Electric power more infuencing factor that enhances the efficiency and performance. Oil is major energy source and 1% Oil eco-efficiency showing big impact four region countries, if 1% Oil reduce Quality and efficiency highly demage air pollution, Electric is less Co_2 emission energy source that enhance eco-efficiency.

Table 5 - External Finance Diversity impact on Eco-efficiency (GMM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	-0.513276	0.113972	-4.503536	0.0000
REMITTANCES	-0.319654	0.079464	-4.022611	0.0001
ODA	0.894965	0.268436	3.334003	0.0013
SDGs	0.114421	0.022814	5.015266	0.0000
GDP	-2.212982	0.294696	-7.509369	0.0000
GDP_PC	2.212158	0.306196	7.224648	0.0000
GC	0.060173	0.112992	0.532545	0.5958
HEALTH	-0.105123	0.111754	-0.940660	0.3497

R-squared	0.947352	Mean dependent var	4.159784
Adjusted R-squared	0.942745	S.D. dependent var	3.603880
S.E. of regression	0.862334	Sum squared resid	59.48966
Durbin-Watson stat	0.327518	J-statistic	27.88844
Instrument rank	9	Prob(J-statistic)	0.000000

01% *** 05% ** 10%

Table 5 is showing External Finance Diversity of four Asian countries of Japan, China, India and Pakistan effect on Eco-efficiency. The generalized method of movements used for penal data for correct assessment. Its use for dynamic penal data combines moment conditions. When the coefficient of the legged dependent variable is near 0.87, GMM estimation is suggested for measuring penal data. The generalized method of movements (GMM) measurement results that indicate the external finance of four Asian countries of Japan, China, India and Pakistan effect on eco-efficiency. FDI -0.513276***, Remittances -0.319654*** and ODA 0.894965*** indicates 1% high significant impact on eco-efficiency. Control variables Sustainable development Goal of UN-Target 2050 is 0.114421***, GDP -2.212982*** and GDP per Capita 2.212158*** highly 1% significant, while Government Consumption 0.060173 and Health -0.105123 less impact on eco-efficiency. Concluding results as External finance (FDI, Remittances and ODA) are an important factor for Eco-efficiency that enhances the efficiency and performance.

Table 6 - Transport Power Diversity impact on Eco-efficiency (GMM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TRANSPORT	0.016816	0.025053	0.671214	0.5040
OIL	2.291111	0.473227	4.841467	0.0000
GAS	0.186995	0.187000	0.999972	0.3204
ELECTRIC	135.6866	13.83665	9.806322	0.0000
SDGs	-0.082610	0.031298	-2.639491	0.0100
GDP	0.044549	0.343425	0.129720	0.8971
GDP_PC	0.001623	0.343044	0.004732	0.9962
GC	0.138707	0.077385	1.792439	0.0769
HEALTH	-0.439809	0.105482	-4.169503	0.0001
R-squared	0.974263	Mean dependent var		4.159784
Adjusted R-squared	0.971656	S.D. dependent var		3.603880
S.E. of regression	0.606733	Sum squared resid		29.08187
Durbin-Watson stat	0.342707	J-statistic		33.55556
Instrument rank	10	Prob(J-statistic)		0.000000

01% *** 05% ** 10%

Table 6 is showing Transport Power Diversity of four Asian countries of Japan, China, India and Pakistan effect on Eco-efficiency. The generalized method of movements used for penal data for correct assessment. Its use for dynamic penal data combines moment conditions. When the coefficient of the legged dependent variable is near 0.87, GMM estimation is suggested for measuring penal data. The generalized method of movements measurement results that indicate the Transport Power Diversity (Oil, Gas, Electric) of four Asian countries of Japan, China, India and Pakistan effect on Eco-efficiency. Overall transport power 0.016816, Oil transport power 2.291111***, Gas 0.186995 and Electric power 135.6866*** indicating significance and important for Eco-efficiency, meanwhile Oil and Electric power diversity results showing 1% highly significant impact on eco-efficiency. Control variable of Sustainable development Goal of UN-Target 2050 is -0.082610*** and Health -0.439809*** highly significant impact on Eco-efficiency. Meanwhile GDP, GDP Per Capita and Government Consumption less impact factor for eco-efficiency. The generalized method of movements' assessment Concluding results as Transport energy diversity is an important for Eco-efficiency, meanwhile Oil and Electric power more infuencing factor that enhances the efficiency and performance. Oil is major energy source and 1% Oil eco-efficiency showing big impact four region countries, if 1% Oil reduce Quality and efficiency highly demage air pollution, Electric is less Co_2 emission energy source that enhance eco-efficiency.

Table 7 - External Finance Diversity impact on Eco-efficiency (Robustness sustainability)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
FDI	-0.322445	0.094880	-3.398454	0.0007
REMITTANCES	-0.418789	0.066153	-6.330624	0.0000
ODA	0.612120	0.223469	2.739172	0.0062
SDGS	0.107614	0.018993	5.666046	0.0000
GDP	-1.992984	0.245330	-8.123675	0.0000
GDP_PC	1.877515	0.254904	7.365584	0.0000
GC	0.196934	0.094064	2.093612	0.0363
HEALTH	-0.310211	0.093034	-3.334396	0.0009
Robust Statistics				
R-squared	0.635193	Adjusted R-squared		0.603273
Rw-squared	0.976513	Adjust Rw-squared		0.976513
Akaike info criterion	131.3701	Schwarz criterion		154.8694
Deviance	43.61048	Scale		0.605243
Rn-squared statistic	5419.259	Prob (Rn-squared stat.)		0.000000
Non-robust Statistics				
Mean dependent var	4.159784	S.D. dependent var		3.603880
S.E. of regression	0.999761	Sum squared resid		79.96181

01% *** 05% ** 10%

The above table 7 shows the robust least square results of four Asian countries of Japan, China, India and Pakistan External finance diversity effect on Eco-efficiency. The robust least square test used for indication results validity and sustainability for a long time. FDI -0.322445***, Remittances -0.418789*** and ODA 0.612120*** indicates 1% high significant for eco-efficiency. Control variables Sustainable development Goal of UN-Target 2050 is 0.107614***, GDP -1.992984***, GDP per Capita 1.877515*** and Health -0.310211*** highly 1% significant and Government Consumption 0.196934** high 5% significant for eco-efficiency. The Robustness assessment test result concluding; External finance is an important factor for Eco-efficiency, External finance Diversity enhances the efficiency and performance of Eco-efficiency. Results also indicate the above indicator data and results are valid and sustainable for long time.

Table 8 - Transport Power Diversity impact on Eco-efficiency (Robustness sustainability)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
TRANSPORT	-0.009203	0.024189	-0.380479	0.7036
OIL	1.475101	0.456901	3.228488	0.0012
GAS	0.374386	0.180549	2.073596	0.0381
ELECTRIC	131.9918	13.35931	9.880136	0.0000
SDGs	-0.042599	0.030218	-1.409706	0.1586
GDP	0.041971	0.331578	0.126579	0.8993
GDP_PC	0.016005	0.331210	0.048322	0.9615
GC	0.120649	0.074715	1.614794	0.1064
HEALTH	-0.491456	0.101843	-4.825597	0.0000
Robust Statistics				
R-squared	0.662464	Adjusted R-squared		0.628283
Rw-squared	0.985261	Adjust Rw-squared		0.985261
Akaike info criterion	133.2523	Schwarz criterion		157.5190
Deviance	22.88523	Scale		0.441846
Rn-squared statistic	7295.872	Prob (Rn-squared stat.)		0.000000
Non-robust Statistics				
Mean dependent var	4.159784	S.D. dependent var		3.603880
S.E. of regression	0.652473	Sum squared resid		33.63194

01% *** 05% ** 10%

The table 8 shows the robust least square results of Transport Power Diversity of four Asian countries of Japan, China, India and Pakistan effect on Eco-efficiency. The robust least square test indicate results are valid and sustainability for a long time. Transport -0.009203, Oil 1.475101***, Gas 0.374386** and Electric 131.9918*** are significant for CO_2 emission reduction. Control varialbes of Sustainable Development Goal UN-Target-2050 is -0.042599, GDP 0.041971, GDP Per Capita 0.016005, Government Consumption 0.120649 and Health -0.491456*** significant for eco-efficiency. The result clearly indicate external finance signifacant for eco-efficiency and external finance (Oil, Gas, and Electric) indicator results more valid and sustainable for long time as compare to others. The Robustness assessment test result concluding; Transport power diversity is an important factor for Eco-efficiency that enhances the efficiency and performance. Results also indicate the above indicator data and results are valid and sustainable for long time.

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

The main two objective of this study; First, to examine the effect of External Finance i.e. FDI, Remittances and ODA-Foreign Aid on Eco-efficiency ~ CO_2 emission reduction and identify the best external finance source that benefit for eco-efficiency and economic development. Second, to examine the effect of Transport Power Diversity i.e. Oil, Gas and Electric on Eco-efficiency ~ CO_2 emission reduction and identify best transportation eco-power energy system. Greenhouse gases is a biggest challenges for worldwide and one fourth of World Transport sector produce CO_2 emission, world is concern to reduce fossil dependency with technology, while transport sector still base on fossil dependency. External finance is a modern tool for technology enhancement, and economic development. This study results also indication for world high finance and fuel dependency.

On average External finance Trend of 4 countries, China FDI, Remittances, and ODA-Foreign Aid have 50%, 2%, 2%; India 26%, 36%, 10%; Pakistan 19%, 61%,75% and Japan 5%, 1%, 13% indication of external finance~ FDI, Remittances, and ODA-Foreign Aid respectively dependency. Trend of external finance of 4 countries, Japan least dependent country, china only face dependency in FDI, while Pakistan major dependency on Remittances and ODA-Foreign Aid, indication for policy maker.

On average Fuel Consumption Trend of 4 countries, Japan fuel, Oil, Gas, and electric energy transport consumption are 28%, 26%, 44%, 70%; Pakistan 41%, 17%, 15%, 3%; India 19%, 24%, 15%, 9% and China 12%, 33%, 26%, 18%, indication of CO_2 emission intensity of fuel, Oil, Gas, and electric energy transport consumption respectively. China and Japan major producer in global and trade is important for world, but never on cost of Air Pollution. Japan Air Pollution policy is better than other three countries with sustain Air Pollution and transport energy power still away from target requirements. While China, India and Pakistan set transport sustainable Air Pollution goals to CO_2 emission reduction and in progress.

Regression least square method measurement results that indicate the external finance (FDI, Remittances, ODA) of four Asian countries of Japan, China, India and Pakistan effect on eco-efficiency. FDI, Remittances and ODA indicate 1% high significant impact on eco-efficiency. The generalized method of movements used for penal data for correct assessment. The GMM results also indicate the external finance of four Asian countries of Japan, China, India and Pakistan similar effect on eco-efficiency. FDI, Remittances, and ODA indicate 1% high significant impact on eco-efficiency. Concluding Regression and GMM results as External finance (FDI, Remittances and ODA) are an important factor for Eco-efficiency that enhances the efficiency and performance. The robust least square test result indicates results are validity and sustainability for a long time.

Moreover, Regression Transport Power of four Asian countries of Japan, China, India and Pakistan effect on Eco-efficiency. Result point out the 1% significance of Oil and Electric energy for Air Pollution because Oil biggest utilization energy source in transportation sector and one point Oil Air Pollution big impact on world, as electric less CO_2 emission source, while Gas is low impact on Air Pollution. The GMM also similar result produced Oil, Electric energy efficiency highly 1% significant for Air Pollution. The robust least square is validity the regression and GMM results of fuel consumption and indication the sustainability for a long period.

Similar studies; As Similar study indicates financial and technology enhancement leads to eco-efficiency, 1% growth in resource injection produce eco-sustainability. Therefore, energy industry has to allow for more private and external participation (L. Zhang, Saydaliev, & Ma, 2022). While digitalized external finance were a positive impact on energy and eco-efficiency (Fu, Zhou, Li, & Zhong, 2023). As similar results, mobilizing external finance and Energy efficiency are critical in south-east Asian nations; it's reducing the temperature produce eco-efficiency and also fast growing energy demand (Azhgaliyeva, Kapoor, & Liu, 2020). Financing structure increased the energy utilization efficiency and reduces the pollution of the ecological environment (Chengying Yang & Masron, 2022).: Similar results finance enhancement inproving the industrial eco-efficiency and performance (Q. Wang, Zhang, & Wang, 2021; W. Zhang, He, & Liu, 2023). External finance~FDI were a negative significant impact on eco-efficiency. While FDI exhibits a eco-efficiency halo effect on economic development and sustainability (H. Deng et al., 2023; Tong, Zhou, & Jiang, 2021). Heaven effect between FDI to eco-efficiency (Zheng, Zhang, Song, & Mu, 2023). Human capital, Remittances, FDI and Technology innovations promotes environmental efficiency in south east and south Asia regions (Twum et al., 2021). Financial development enhance technology, therefore positive significant impact on eco-efficiency (Cui, Wang, Chen, Ren, & Gao, 2023). Financial Resouce efficiency were benefit for motivate foreging investor, saving energy, renewable energy, minimize waste, recycling, and

promoting environment eco-efficiency. More specifically, external fiannce and energy resource efficiency action impact on produc tion costs, investment, sustainability and performance (Majid et al., 2023). Similar studies also validate our result that indication study has valueable.

External finance and Transportation energy power implication and recommendation is much cleared, external finance has a modern finance source for technology enhancement and economy. Transport Cargo system need to be design according eco-friendly system. Government need to enacting policies to encourage foreigner to invest eco-friendly project like modern technology enhancement, people to move away from gasoline and diesel transportation until modern technology eco-efficient, Electric power system is an alternative of fossil power generation toward CO_2 emission reduction.

In sharply, technology must be able to achieve the highest CO_2 reduce potential and external financial resource helpful for technology enhancement. Paris agreement on climate 2015 was most successful agreement between the advancing global world to set a target to meet eco-environment efficiency and reduce CO_2 emission.

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