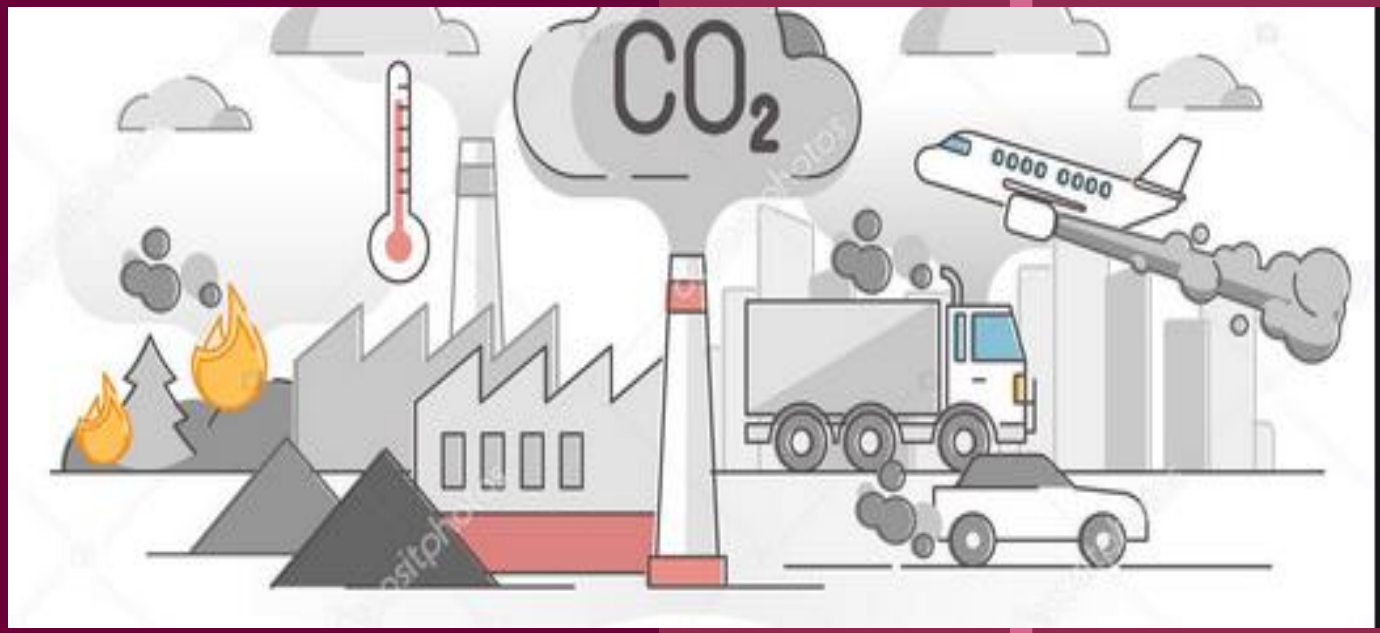
DETERMINANTS OF CO2 EMISSIONS IN ASEAN MEMBER STATES

IMAMUDIN YULIADI

DEPARTMENT OF ECONOMICS

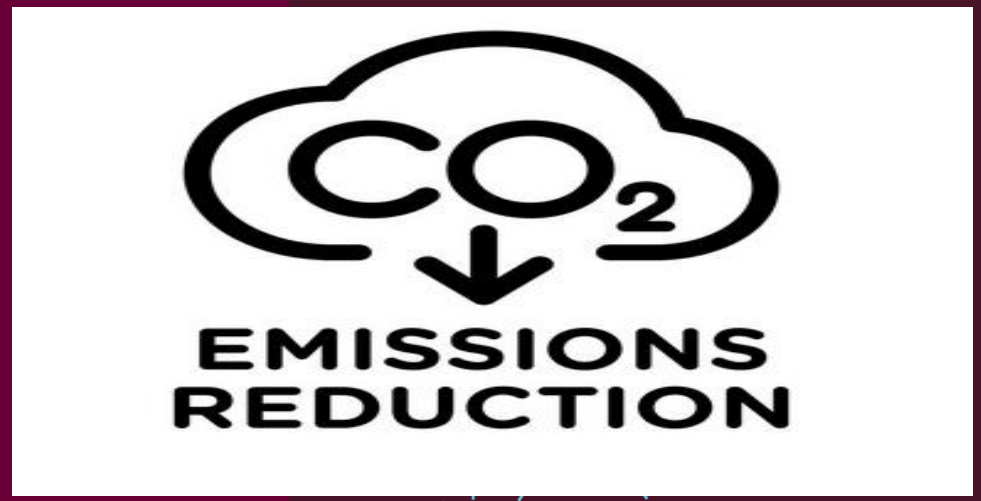
FACULTY OF ECONOMICS AND BUSINESS

UNIVERSITAS MUHAMMADIYAH YOGYAKARTA, INDONESIA



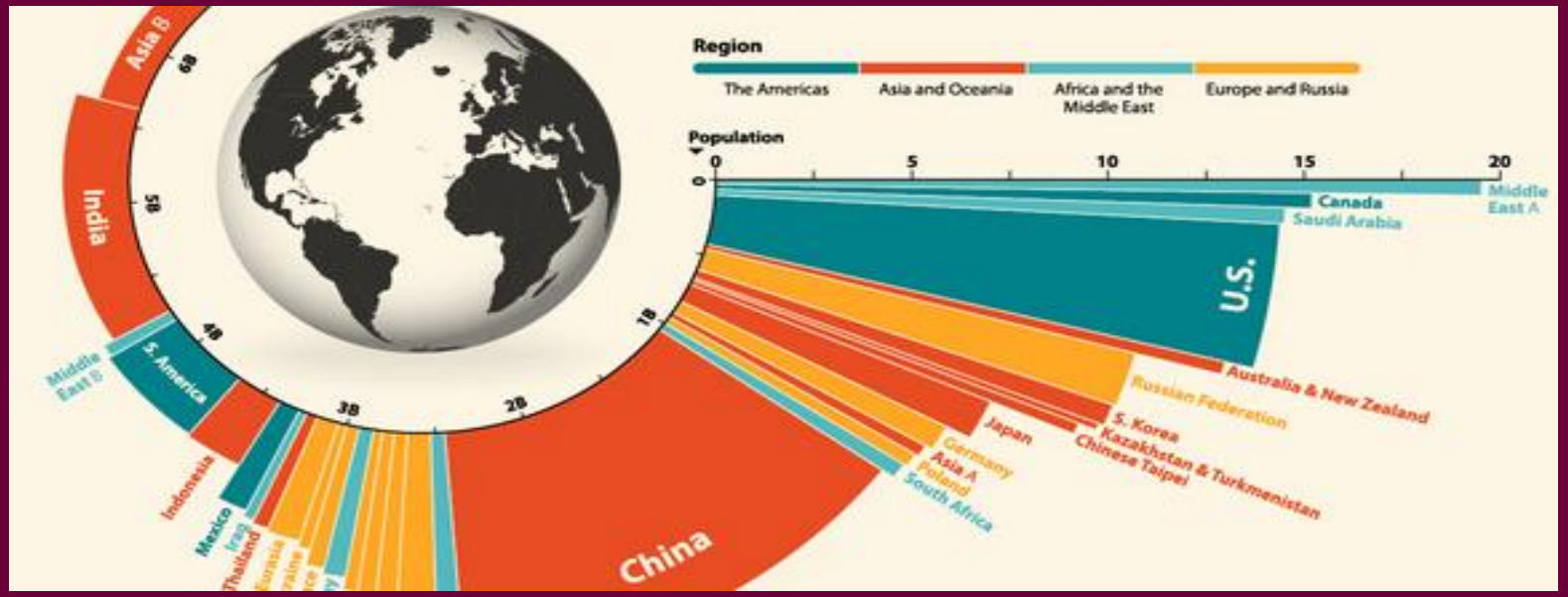
OUTLINE

- INTRODUCTION
- GOALS OF THE RESEARCH
- THEORITICAL FRAMEWORK
- RESEARCH METHODOLOGY
- FINDING AND DISCUSSIONS
- CONCLUSIONS



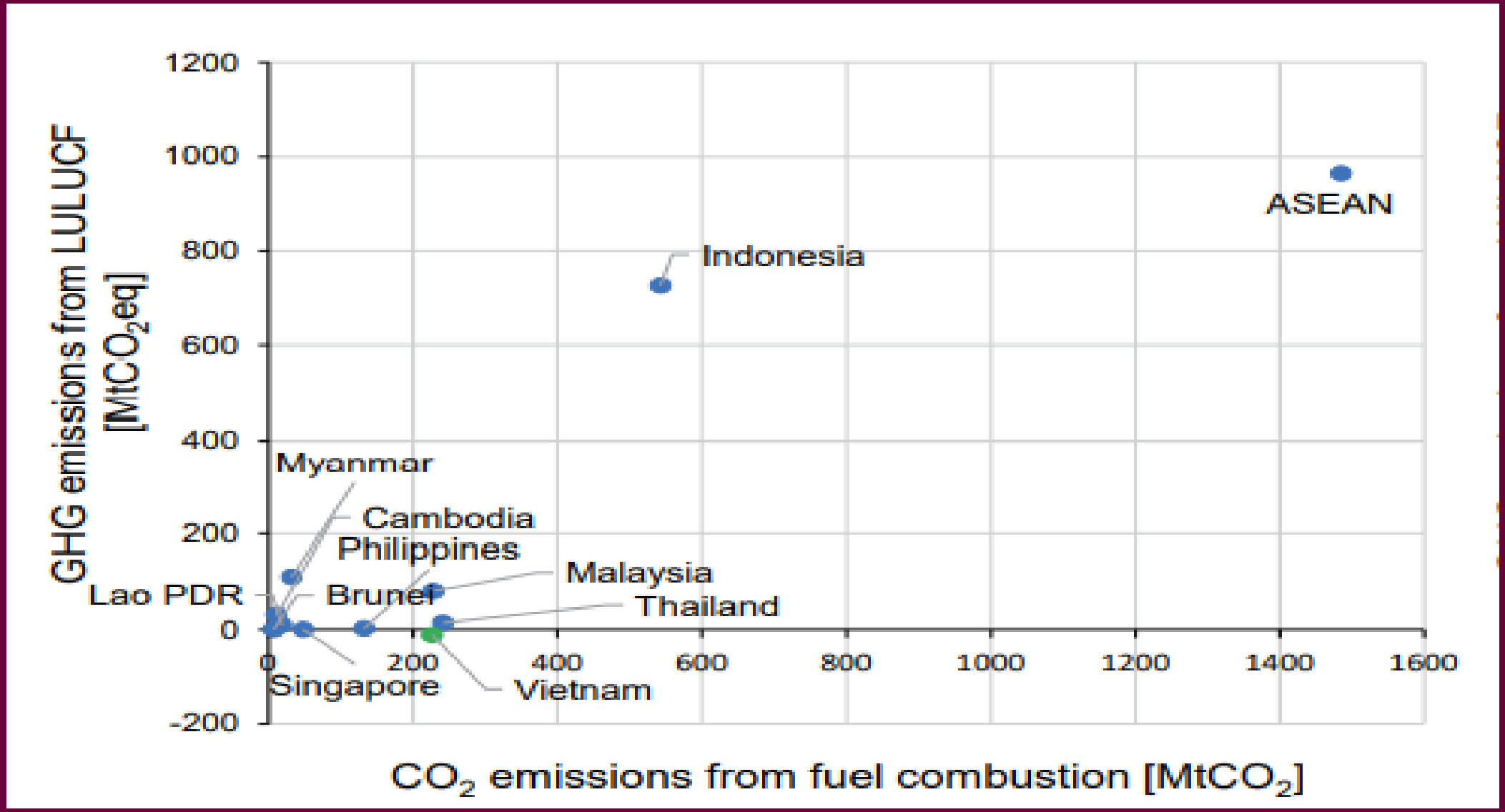
INTRODUCTION

The ASEAN region is a strategic area that is experiencing rapid economic growth, supported by natural wealth, work ethic and a large population, making it the target of foreign direct investment (FDI) and multinational corporations (MNCs). ASEAN countries which have an impact on the decline in the quality of life of the people and in the long term will also have an impact on the sustainability of the economic development of the ASEAN countries. The implications of rapid economic growth through the entry of foreign investment (FDI) and local economic activities have an impact on environmental issues, namely the continued increase in the production of carbon gas emissions (CO2) as an effect of industrialization activities



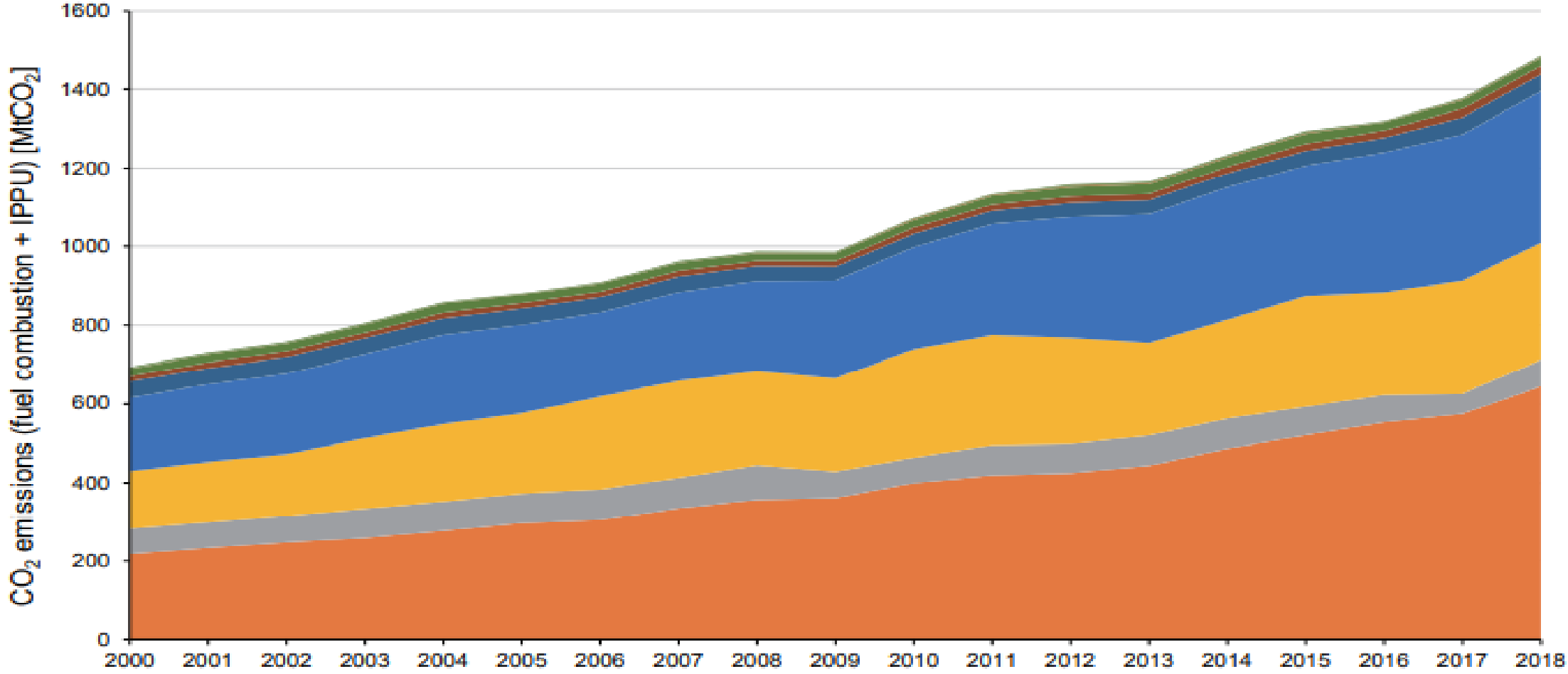
Increasing of CO2 carbon emissions is caused by increasing the consumption of fossil fuels to support activities in the industrial, transportation, household and trade sectors. The impact of increasing CO2 carbon emissions is climate change and increasing in the earth's temperature which has the potential to cause environmental changes and damage to natural ecosystems. The phenomenon of increasing CO2 carbon emissions is also triggered by increased deforestation and conversion of agricultural land for non-agricultural activities so that the plant population as a CO2 absorber is decreasing.

DATA AND FACT



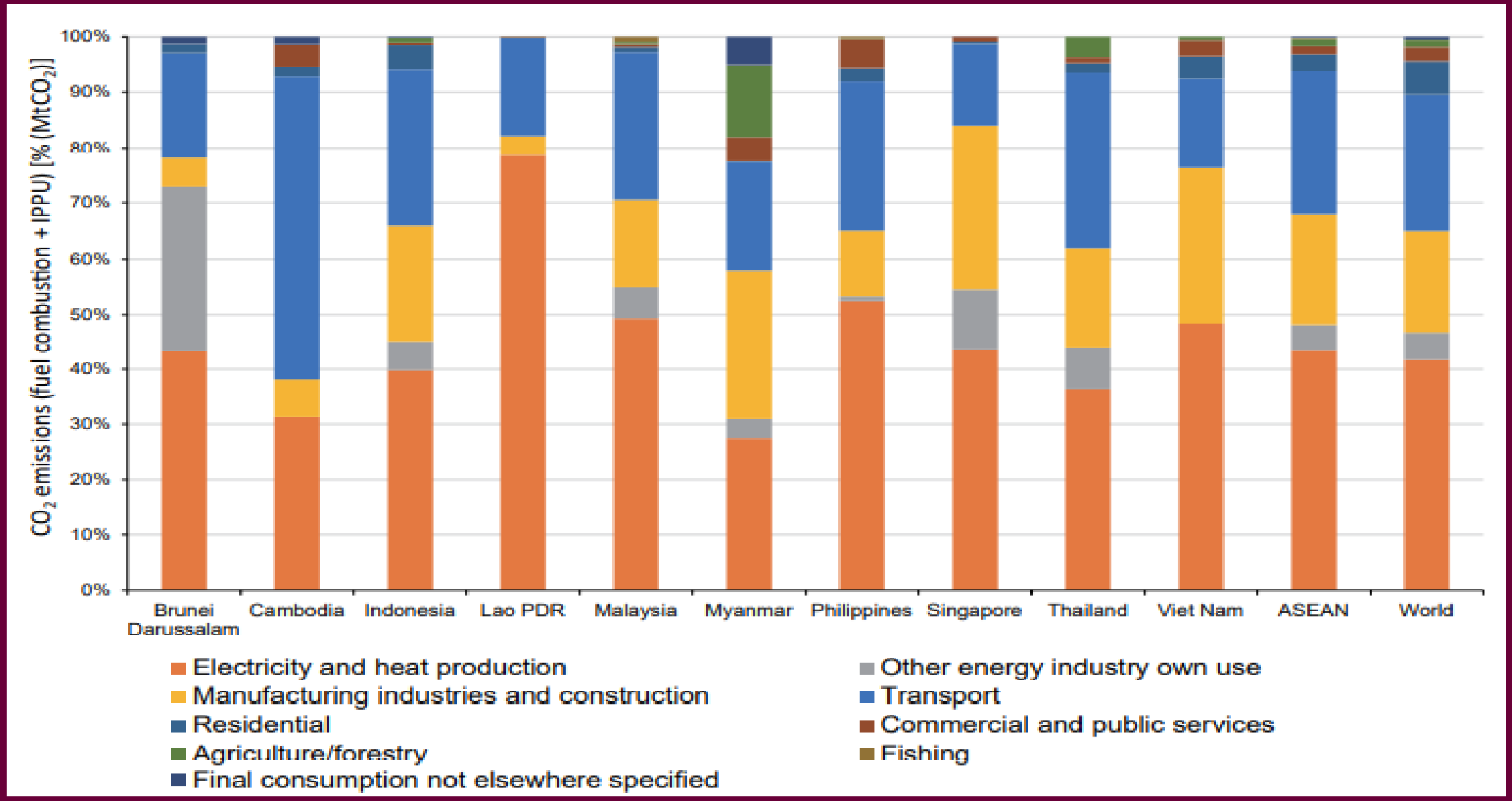
Source : ASEAN State of Climate Change Report, 2021

DATA AND FACT



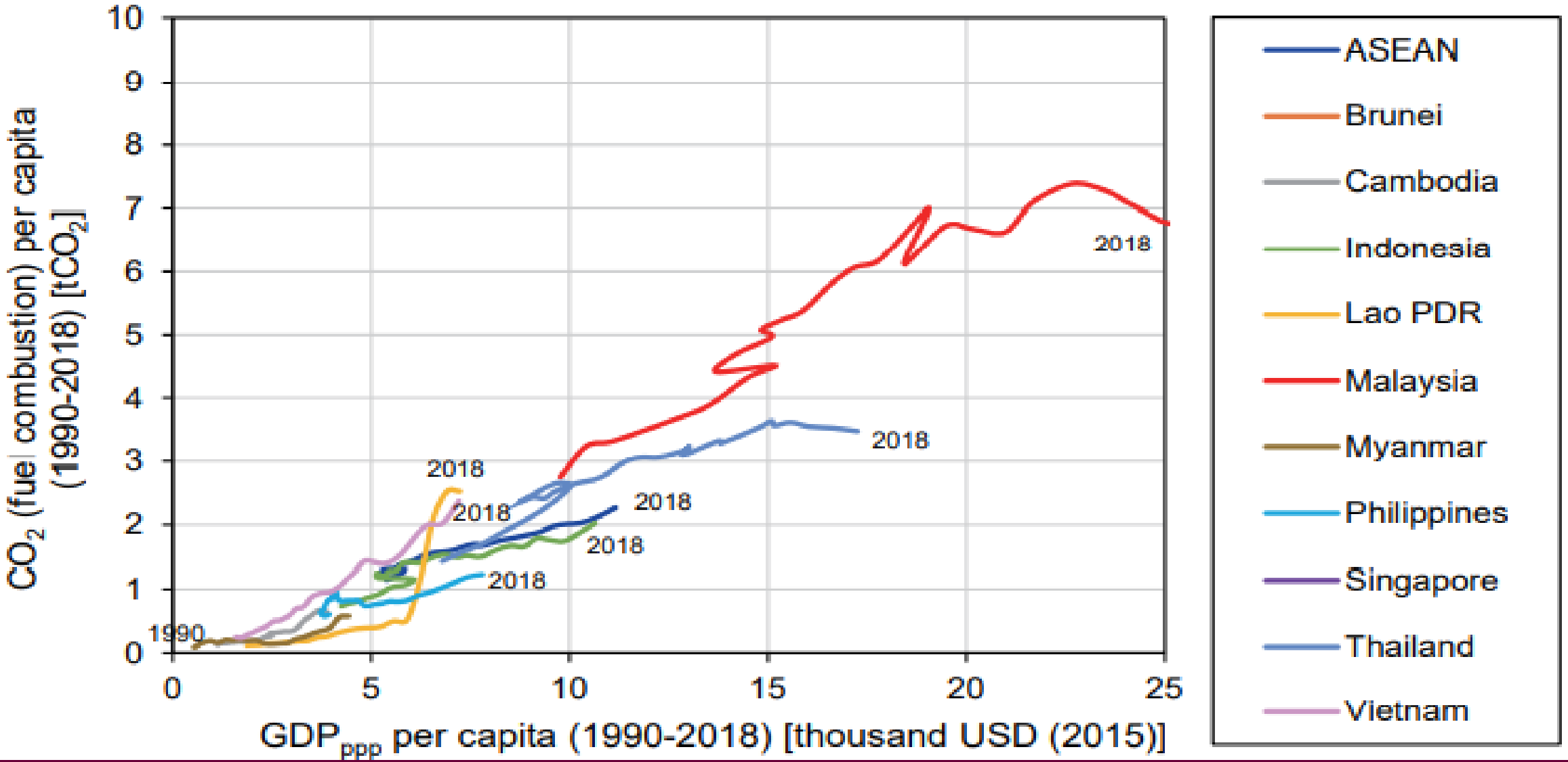
Source : ASEAN State of Climate Change Report, 2021

DATA AND FACT



Source : ASEAN State of Climate Change Report, 2021

DATA AND FACT



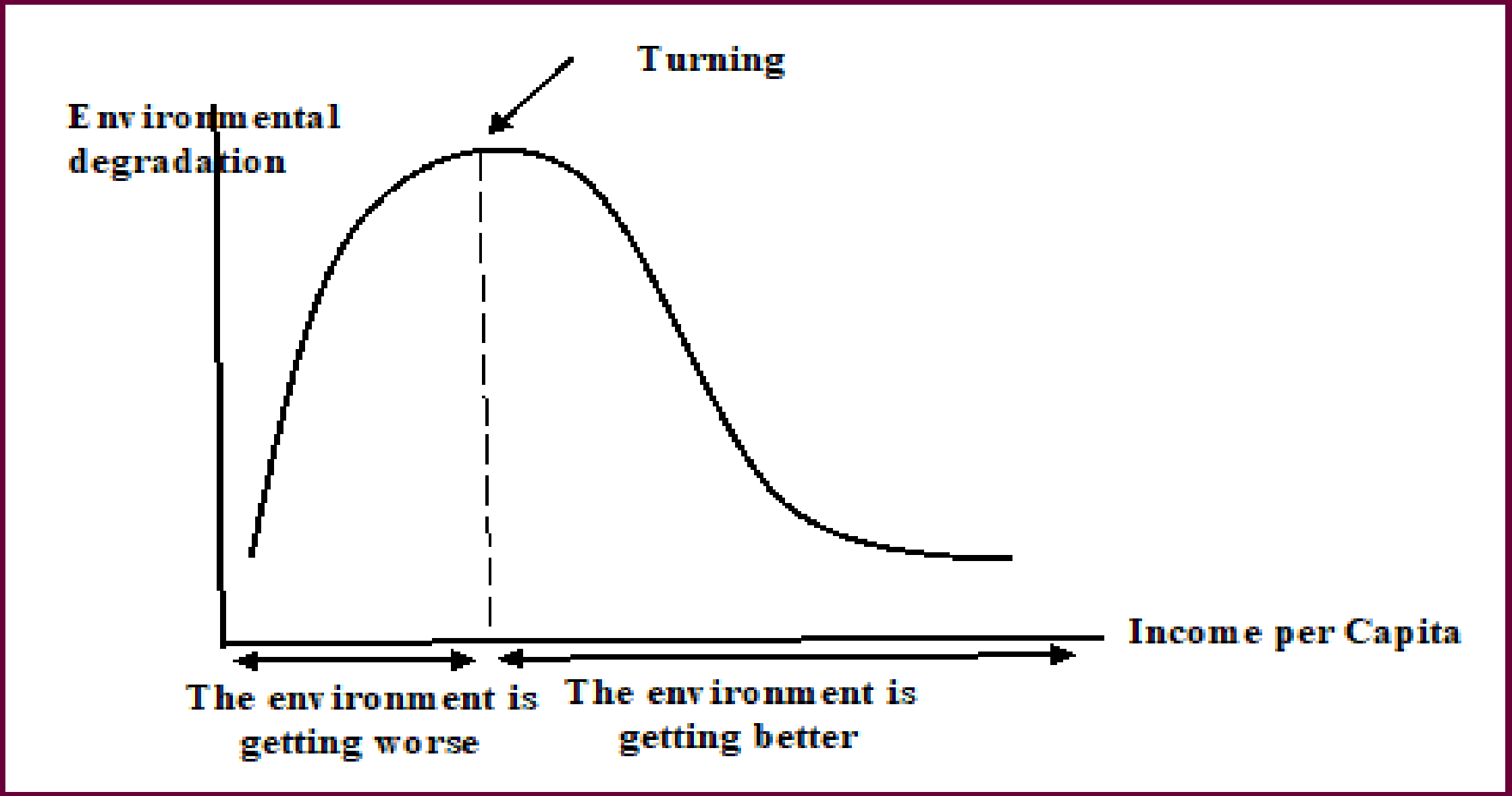
Source : ASEAN State of Climate Change Report, 2021

THEORITICAL FRAMEWORK

Yolanda and Rodriguez (2012) which examined 15 OECD countries for the period 1980-2004 rejected the EEC hypothesis, oil prices were significant in all model specifications with a negative sign, gas and coal prices were not significant (substitution effect with oil prices), production renewable energy is significant for emissions with a negative si

The control variables of the Kuznets curve hypothesis regarding the environment have identical features. For example, studies using exports, imports, and trade openness as proxies for international trade in two developed and developing countries (e.g., Bento and Moutinho, 2016, for Italy; Halicioglu 2009, for Turkey; Jayanthakumar et al., 2012, for China and India). However, not only the volume of trade but also the diversity of export products can significantly affect CO2 emissions and efforts to add new products to the export basket can lead to an increase in co2 emissions.

Stern (2003) reveals that the use or consumption of energy is a means to drive the industrialization of the economy as well as a means of accumulation of development capital, either complementary or substitute in producing outputs in the economy.



Source : Todaro, 2006

RESEACH GOALS

- Analyzing the effect of economic growth on CO2 emissions in ASEAN member state
- Analysing the effect of population on CO2 emissions in ASEAN member state
- Analyzing the effect of foreign direct investment (FDI) on CO2 emissions in ASEAN member state
- Analyzing the impact of export on CO2 emissions in ASEAN member state
- Analyzing the impact of foreign debt on CO2 emissions in ASEAN member state
- Analyzing the impact of inflation on CO2 emissions in ASEAN member state
- Analyzing the impact of energy consumption on CO2 emissions in ASEAN member state

RESEARCH METHODOLOGY

$$Y = \alpha_o + \alpha_1 X_{1it} + \alpha_2 X_{2it} + \alpha_3 X_{3it} + \alpha_4 X_{4it} + \alpha_2 X_{5it} + \alpha_3 X_{6it} + \alpha_3 X_{7it} + e_{it}$$

Which :

Y = CO2 Emissions

X_{1it} = Gross Domestic Product (GDP) country-i at year-t

X_{2it} = Total Population country-i at year-t

X_{3it} = Foreign Debt country-i at year-t

X_{4it} = Export country-i at year-t

X_{5it} = Foreign Direct Investment (FDI) country-i at year-t

X_{6it} =Inflation country-i at year-t

X_{7it} = Energy Consumption country-i at year-t

Pooling data analyasis
Source of data : World Bank, 2010-2019
ASEAN member states :
Indonesia, Singapore, Malaysia, Thailand, Laos, Kamboja, Vietnam, Brunei Darussalam, and Philipines

MODEL ANALYSIS

FINDING AND ANALYSIS

COMMON EFFECT MODEL

Source	SS	df	MS		
Model	182.267855	7	26.038265	Prob > F	0.0000
Residual	96.0127939	90	1.06680882	R-squared	0.6550
Total	278.280649	97	2.86887267	Root MSE	1.0329

co2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pop	.1631729	.2054993	0.79	0.429	-.2450873	.571433
gdp	.1843744	.1843594	1.00	0.320	-.1818878	.5506366
fdi	.1212378	.0362113	3.35	0.001	.0492978	.1931779
export	.016272	.0040443	4.02	0.000	.0082372	.0243068
energyconsumption	.0279311	.008149	3.43	0.001	.0117417	.0441204
inflansi	-.1373929	.0443212	-3.10	0.003	-.2254447	-.0493411
uln	.0044804	.0995648	0.04	0.964	-.1933225	.2022832
_cons	-.6089892	2.453031	-0.25	0.804	-5.482363	4.264384

FIXED EFFECT MODEL

Fixed-effects (within) regression — Number of obs = 98
Group variable: Code — Number of groups = 10

R-sq:
within = 0.0969
between = 0.1037
overall = 0.0531

Obs per group:
min = 9
avg = 9.8
max = 10

F(7,81) = 1.24
corr(u_i, Xb) = -0.9269 — Prob > F = 0.2902

co2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pop	1.773523	3.183221	0.56	0.579	-4.560087	8.107134
gdp	-.1647267	.2056599	-0.80	0.425	-.5739253	.2444719
fdi	-.1135057	.0815254	-1.39	0.168	-.2757156	.0487042
export	.0176808	.0131458	1.34	0.182	-.0084751	.0438368
energyconsumption	.0174188	.0213225	0.82	0.416	-.0250062	.0598438
inflansi	-.0816219	.0489842	-1.67	0.100	-.1790851	.0158412
uln	-.1218881	.1325853	-0.92	0.361	-.3856912	.141915
_cons	-20.16946	53.4949	-0.38	0.707	-126.6075	86.26861
sigma_u	4.0246933					
sigma_e	.95377019					
rho	.94682684	(fraction of variance due to u_i)				

F test that all u_i=0: F(9, 81) = 2.73 — Prob > F = 0.0079

RANDOM EFFECT MODEL

```
Random-effects GLS regression                   Number of obs      =        98
Group variable: Code                            Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.0300                                         min =         9
     between = 0.9277                                         avg =       9.8
     overall = 0.6475                                         max =        10

                                                Wald chi2(7)       =     59.85
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

co2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
pop	.1102245	.2398592	0.46	0.646	-.3598909	.58034
gdp	.1233562	.1862625	0.66	0.508	-.2417117	.488424
fdi	.0911742	.0479087	1.90	0.057	-.0027252	.1850735
export	.0161089	.0051775	3.11	0.002	.0059613	.0262566
energyconsumption	.0322306	.0115936	2.78	0.005	.0095075	.0549537
inflansi	-.1152986	.0453554	-2.54	0.011	-.2041935	-.0264037
uln	.0170811	.1049397	0.16	0.871	-.1885969	.2227591
_cons	.8813847	3.271384	0.27	0.788	-5.53041	7.29318
sigma_u	.43988662					
sigma_e	.95377019					
rho	.17540258	(fraction of variance due to u_i)				

PRESENCE COUNTRY FIXED EFFECT MODEL

Source	SS	df	MS
Model	204.596766	16	12.7872979
Residual	73.683883	81	.909677568
Total	278.280649	97	2.86887267

Number of obs	=	98
F(16, 81)	=	14.06
Prob > F	=	0.0000
R-squared	=	0.7352
Adj R-squared	=	0.6829
Root MSE	=	.95377

co2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pop	1.773523	3.183221	0.56	0.579	-4.560087	8.107134
gdp	-.1647267	.2056599	-0.80	0.425	-.5739253	.2444719
fdi	-.1135057	.0815254	-1.39	0.168	-.2757156	.0487042
export	.0176808	.0131458	1.34	0.182	-.0084751	.0438368
energyconsumption	.0174188	.0213225	0.82	0.416	-.0250062	.0598438
inflansi	-.0816219	.0489842	-1.67	0.100	-.1790851	.0158412
uln	-.1218881	.1325853	-0.92	0.361	-.3856912	.141915
ndum2	1.930014	4.062585	0.48	0.636	-6.153256	10.01328
ndum3	-.1151166	3.005593	-0.04	0.970	-6.095304	5.865071
ndum4	.660888	2.879106	0.23	0.819	-5.06763	6.389406
ndum5	5.919416	11.83465	0.50	0.618	-17.62783	29.46666
ndum6	13.15958	20.2832	0.65	0.518	-27.19763	53.51679
ndum7	3.594103	6.602355	0.54	0.588	-9.542513	16.73072
ndum8	.3917805	4.838709	0.08	0.936	-9.235733	10.01929
ndum9	1.749409	8.582348	0.20	0.839	-15.32677	18.82559
ndum10	2.913188	11.26268	0.26	0.797	-19.496	25.32238
_cons	-23.11314	60.63473	-0.38	0.704	-143.7572	97.53094

PRESENCE TIME FIXED EFFECT MODEL

Source	SS	df	MS
Model	194.256194	16	12.1410121
Residual	84.0244551	81	1.03733895
Total	278.280649	97	2.86887267

Number of obs	= 98
F(16, 81)	= 11.70
Prob > F	= 0.0000
R-squared	= 0.6981
Adj R-squared	= 0.6384
Root MSE	= 1.0185

co2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pop	.1857064	.2154447	0.86	0.391	-.2429609	.6143737
gdp	.1746901	.1948043	0.90	0.373	-.2129094	.5622896
fdi	.1251898	.0364669	3.43	0.001	.0526322	.1977474
export	.0164709	.0041655	3.95	0.000	.0081829	.0247589
energyconsumption	.0278229	.008124	3.42	0.001	.0116587	.0439871
inflansi	-.1542803	.0477248	-3.23	0.002	-.2492376	-.059323
uln	.0035427	.1040892	0.03	0.973	-.2035621	.2106475
tdum2	.3856325	.4583496	0.84	0.403	-.5263394	1.297604
tdum3	-.1859324	.464219	-0.40	0.690	-1.109583	.7377177
tdum4	.3902469	.4616124	0.85	0.400	-.5282169	1.308711
tdum5	.1030365	.4587117	0.22	0.823	-.8096559	1.015729
tdum6	.089779	.4708641	0.19	0.849	-.847093	1.026651
tdum7	.3043373	.4951137	0.61	0.540	-.6807836	1.289458
tdum8	.0349999	.4734491	0.07	0.941	-.9070154	.9770151
tdum9	.7742068	.4644039	1.67	0.099	-.1498113	1.698225
tdum10	-.6287097	.4804551	-1.31	0.194	-1.584665	.3272452
_cons	-.9884228	2.504537	-0.39	0.694	-5.971666	3.99482

PANEL WHITE STANDARD ERROR

Linear regression

Number of obs	= 98
F(16, 81)	= 26.55
Prob > F	= 0.0000
R-squared	= 0.6981
Root MSE	= 1.0185

co2	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
pop	.1857064	.1973053	0.94	0.349	-.2068693	.5782821
gdp	.1746901	.187273	0.93	0.354	-.1979244	.5473047
fdi	.1251898	.0350609	3.57	0.001	.0554297	.1949499
export	.0164709	.0034793	4.73	0.000	.0095483	.0233936
energyconsumption	.0278229	.0099951	2.78	0.007	.0079357	.04771
inflansi	-.1542803	.0759564	-2.03	0.046	-.3054098	-.0031509
uln	.0035427	.0856717	0.04	0.967	-.1669172	.1740026
tdum2	.3856325	.4023133	0.96	0.341	-.4148447	1.18611
tdum3	-.1859324	.4222534	-0.44	0.661	-1.026084	.6542193
tdum4	.3902469	.3149061	1.24	0.219	-.2363175	1.016811
tdum5	.1030365	.3241188	0.32	0.751	-.5418583	.7479313
tdum6	.089779	.4884385	0.18	0.855	-.8820605	1.061618
tdum7	.3043373	.4592833	0.66	0.509	-.6094924	1.218167
tdum8	.0349999	.4000992	0.09	0.931	-.7610721	.8310718
tdum9	.7742068	.3319136	2.33	0.022	.1138028	1.434611
tdum10	-.6287097	.7413079	-0.85	0.399	-2.10368	.8462605
_cons	-.9884228	2.440745	-0.40	0.687	-5.844739	3.867893

PANEL FEASIBLE GENERALIZED LEAST SQUARES

```
Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        homoskedastic
Correlation:   no autocorrelation

Estimated covariances      =         1          Number of obs      =        98
Estimated autocorrelations =         0          Number of groups   =        10
Estimated coefficients     =        17          Obs per group:
                                                              min =         9
                                                              avg =       9.8
                                                              max =        10
                                                Wald chi2(16)      =    226.57
Log likelihood             = -131.5169          Prob > chi2        =    0.0000
```

co2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
pop	.1857064	.1958688	0.95	0.343	-.1981894	.5696022
gdp	.1746901	.1771039	0.99	0.324	-.1724271	.5218074
fdi	.1251898	.0331534	3.78	0.000	.0602104	.1901693
export	.0164709	.003787	4.35	0.000	.0090486	.0238933
energyconsumption	.0278229	.0073858	3.77	0.000	.0133469	.0422988
inflansi	-.1542803	.0433884	-3.56	0.000	-.2393199	-.0692407
uln	.0035427	.0946313	0.04	0.970	-.1819314	.1890167
tdum2	.3856325	.4167027	0.93	0.355	-.4310898	1.202355
tdum3	-.1859324	.4220388	-0.44	0.660	-1.013113	.6412484
tdum4	.3902469	.419669	0.93	0.352	-.4322893	1.212783
tdum5	.1030365	.4170319	0.25	0.805	-.714331	.920404
tdum6	.089779	.4280802	0.21	0.834	-.7492427	.9288006
tdum7	.3043373	.4501263	0.68	0.499	-.5778941	1.186569
tdum8	.0349999	.4304302	0.08	0.935	-.8086279	.8786276
tdum9	.7742068	.4222069	1.83	0.067	-.0533036	1.601717
tdum10	-.6287097	.4367997	-1.44	0.150	-1.484821	.2274019
_cons	-.9884228	2.276968	-0.43	0.664	-5.451198	3.474352

PANEL CORRECTED STANDARD ERROR

```
Number of gaps in sample:  1

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:     Code                            Number of obs      =        98
Time variable:      tahun                           Number of groups   =        10
Panels:             correlated (unbalanced)         Obs per group:
Autocorrelation:    no autocorrelation                                 min =         9
Sigma computed by casewise selection                                   avg =       9.8
                                                                       max =        10
Estimated covariances      =         55             R-squared          =    0.6981
Estimated autocorrelations =          0             Wald chi2(9)       =  226120.27
Estimated coefficients     =         17             Prob > chi2        =    0.0000
```

co2	Panel-corrected Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
pop	.1857064	.1828175	1.02	0.310	-.1726092	.5440221
gdp	.1746901	.1565228	1.12	0.264	-.132089	.4814693
fdi	.1251898	.0235994	5.30	0.000	.0789359	.1714438
export	.0164709	.003698	4.45	0.000	.0092229	.0237189
energyconsumption	.0278229	.0080185	3.47	0.001	.0121069	.0435388
inflansi	-.1542803	.0440175	-3.50	0.000	-.240553	-.0680076
uln	.0035427	.0796559	0.04	0.965	-.1525801	.1596654
tdum2	.3856325	.0474882	8.12	0.000	.2925574	.4787075
tdum3	-.1859324	.0792773	-2.35	0.019	-.341313	-.0305518
tdum4	.3902469	.068447	5.70	0.000	.2560933	.5244006
tdum5	.1030365	.0532113	1.94	0.053	-.0012557	.2073287
tdum6	.089779	.0944013	0.95	0.342	-.0952442	.2748021
tdum7	.3043373	.127624	2.38	0.017	.0541989	.5544756
tdum8	.0349999	.1075416	0.33	0.745	-.1757779	.2457776
tdum9	.7742068	.0885892	8.74	0.000	.6005752	.9478383
tdum10	-.6287097	.1209286	-5.20	0.000	-.8657255	-.391694
_cons	-.9884228	2.120035	-0.47	0.641	-5.143616	3.16677

CONCLUSION

The estimation results show that the variables of FDI, exports, energy consumption and inflation have an effect on CO2 emissions in ASEAN countries. This empirical finding shows a significant correlation between industrialization strategies driven by ASEAN countries and CO2 emissions. The increase in energy consumption for transportation, household needs, education, health, hotels and restaurants also triggers an increase in CO2 emissions. The recommendation from the results of this research is that it is necessary to develop an integrated policy from upstream to downstream in the industrialization strategy by utilizing new and renewable energy sources. There needs to be a fair and rational policy at the global level to reduce CO2 emissions, which are mostly carried out by developed industrial countries. Collective awareness and integrated policies from all components of society are needed to preserve forests as the lungs of the world to reduce environmental degradation and the negative impact of CO2 emissions.

THANK YOU

WASSALAAMU’ALAIKUM WR. WB.