

**Innovation of Mathematics Education through Lesson Study
Textbook Development for SDGs, STEM, and
Energy by Cross-border Education
The case of Indonesia**

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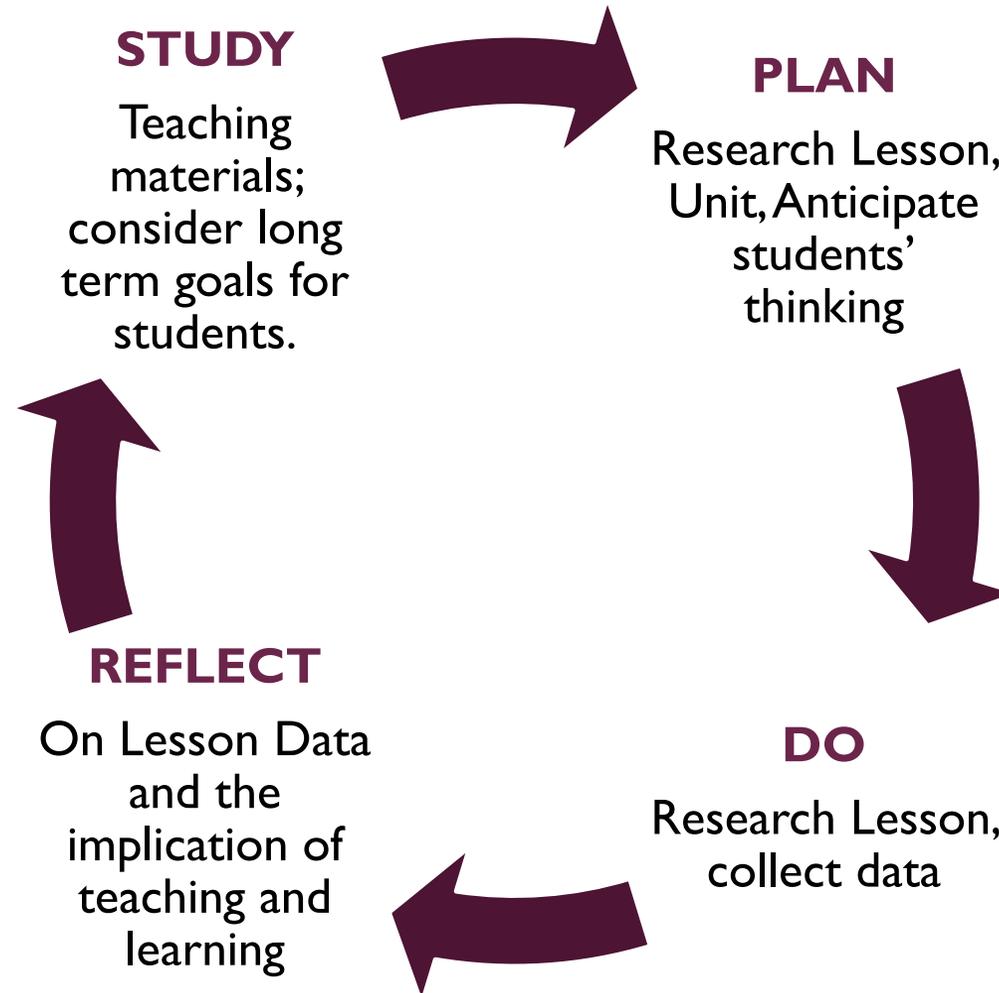
BACKGROUND

As a continuation of APEC-Tsukuba and UNESCO (MGIEP) International Conference XI, which was held in Tokyo, February 9-12, 2017,

Indonesia and Thailand have embarked on Cross-Border Lesson Study together. The cross-border lesson study was conducted on August 8, 2017.

Tasks using APEC Energy Database. The preparation start in the beginning of June

LESSON STUDY

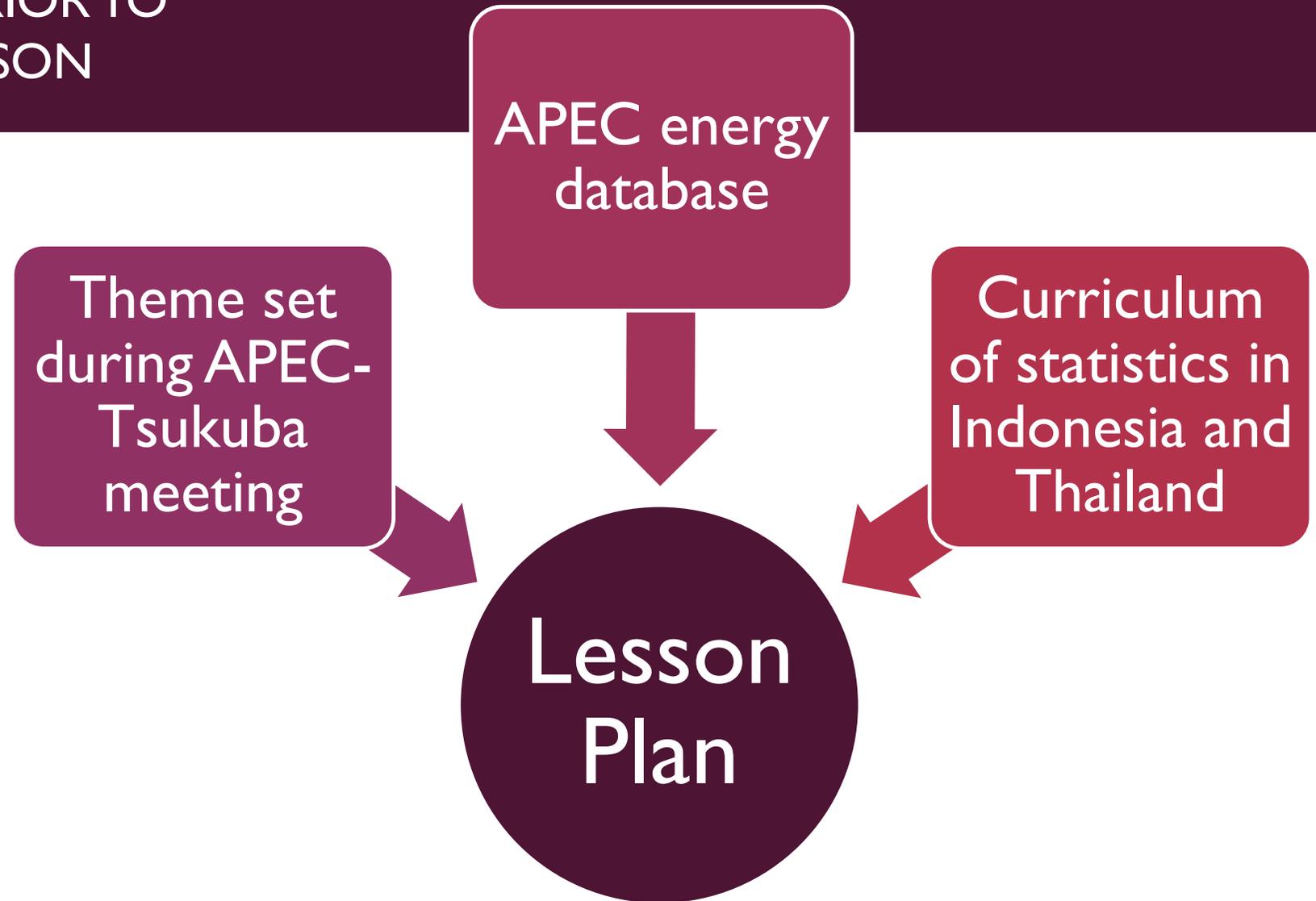


(Lewis, 2016)

PHASE I: STUDY



CONSIDERATION PRIOR TO DESIGNING THE LESSON



THE THEME OF THE LESSON

“Imagine hidden variables and relations through the questioning the graphs, and appreciate the significance of being able to analyze the situation and predict the future by using them.”

APEC DATABASE



**Asia-Pacific
Economic Cooperation**

EGEDA
under EWG-APEC

Expert Group on Energy Data Analysis

Energy

Annual Data

Energy Balance

Energy Balance Tables

Energy Balance Tables in Physical Units

Electricity

Electricity Power Generation

Fuel Consumption for Electricity

* Under Maintenance

Electricity Generating Capacity

Others

Primary Energy Supply

Final Energy Consumption

Demand and Supply by Energy Sector

Stock Change

Quarterly Data

Original Table(New format)

Original Table(Old format)

Monthly Data

Introduction

Total	Coal & Coal Products
	Crude Oil & Petroleum Products
	...
Agriculture	Coal & Coal Products
	Crude Oil & Petroleum Products
	...
...	...

Australia, Agriculture

[Energy \ Time]	1980
Coal & Coal Products	
Crude Oil & Petroleum Products	
...	

Coal & Coal Products, Agriculture

[Member \ Time]	1980
Australia	
Brunei	
...	

Final Energy Consumption Table

Term	Member(s)	Energy	Sector	Unit
1980 ▾	<input type="checkbox"/> (Un)check All <input type="checkbox"/> Australia <input type="checkbox"/> Brunei Darussalam <input type="checkbox"/> Canada <input type="checkbox"/> Chile <input type="checkbox"/> China <input type="checkbox"/> Hong Kong, China <input type="checkbox"/> Indonesia <input type="checkbox"/> Japan <input type="checkbox"/> Republic of Korea <input type="checkbox"/> Malaysia <input type="checkbox"/> Mexico <input type="checkbox"/> New Zealand <input type="checkbox"/> Papua New Guinea <input type="checkbox"/> Peru <input type="checkbox"/> Philippines <input type="checkbox"/> Russia <input type="checkbox"/> Singapore <input type="checkbox"/> Chinese Taipei <input type="checkbox"/> Thailand <input type="checkbox"/> United States of America <input type="checkbox"/> Vietnam <input type="checkbox"/> APEC Total	Coal & Coal Products ▾	Total Final Energy Consumption ▾	<input checked="" type="radio"/> kTOE = 10 ¹⁰ kcal <input type="radio"/> Peta Joule = 10 ¹⁵ Joule
2014 ▾				

CURRICULUM ON STATISTICS IN INDONESIA

Grade 7

- Types of data
- Representing data

Grade 8

- Measures of central tendency
- Probability

Grade 9

PHASE II: PLAN



TIMELINE

DATE	ACTIVITIES
22 May – 21 July, 2017	Desining lesson plan
2 June – 23 July 2017	Discussing and editing lesson plan together between Thailand and Indonesia via email and video call
24-31 July, 2017	Prepare for Cross Border Lesson study
1 and 8 August, 2017	Cross-border Lesson study between Thailand and Indonesian students
	Writing of the Report

INDONESIAN TEAM



Researchers

Dr. Wahyudi

Ms. Russasmita Sri Padmi

Ms. Fina Hanifa Hidayati

Ms. Mutiatul Hasanah

Model teacher

Darto

Staffs

Mr. Deni Saputra

Mr. Febriarto

Mr. Agus

THAILAND TEAM

Maitree Inprasith

Nalumon Inprasith

Auijit Pattanajak

Narumon Changsri

Phuangthong Poonrueng

Prapawadee Suwannatrai

THE LESSON PLAN

Title: The Cost of Our Bright World

Grade: 9

Topic: Statistics (in the context of energy)

Materials:

- Worksheets 1.1 and 1.2 (for students)
- PowerPoint presentation (for teacher)
- Graph paper or graphing software (Ms. Excel)
- projector and screen
- A3 graphing paper.
- WebEx meeting room and internet connection

SDG to be addressed:

SDG 13: take urgent action to combat climate change and its impacts.

SDG 7: ensure access to affordable, reliable, and sustainable energy for all.

LESSON OBJECTIVES

- **represent** and **describe** energy-related data in the form of tables, graph, and charts
- **interpret** data in the context of energy
- **explain** the correlation between different energy consumption and CO₂ emission

OVERVIEW OF THE TASK

Focus was on

- The data of electricity consumption and CO₂ emission.
- Analyzing data visually, mainly through the shape of the graph.

Meeting 1 (Worksheet 1)

The students compare electricity consumption of Indonesia and Thailand using APEC Energy Database. This meeting is conducted separately in each country.

Meeting 2 (Worksheet 2)

The students investigate the primary source of energy used to generate electricity and how it is related to CO₂ emission. This meeting is connected via WebEx.

Worksheet 1

THE COST OF OUR BRIGHT WORLD

How much electricity do Indonesia and Thailand use?



“Which country, between Thailand and Indonesia, consume more electricity?”
“What could be the reason behind this phenomenon?”

Worksheet 1

THE COST OF OUR BRIGHT WORLD

How much electricity do Indonesia and Thailand use?



The table on the right shows electricity comparison of Thailand and Indonesia during the period 1990-2014.

Represent the data in the form of line graph; blue pen for Indonesia and red pen for Thailand. You can also plot it on Microsoft Excel and then copy it to the grid provided below.

Use the graph to help you answer the given questions in the following pages.

Data can be accessed online at:

<http://www.egeda.ewg.apec.org/egeda/>

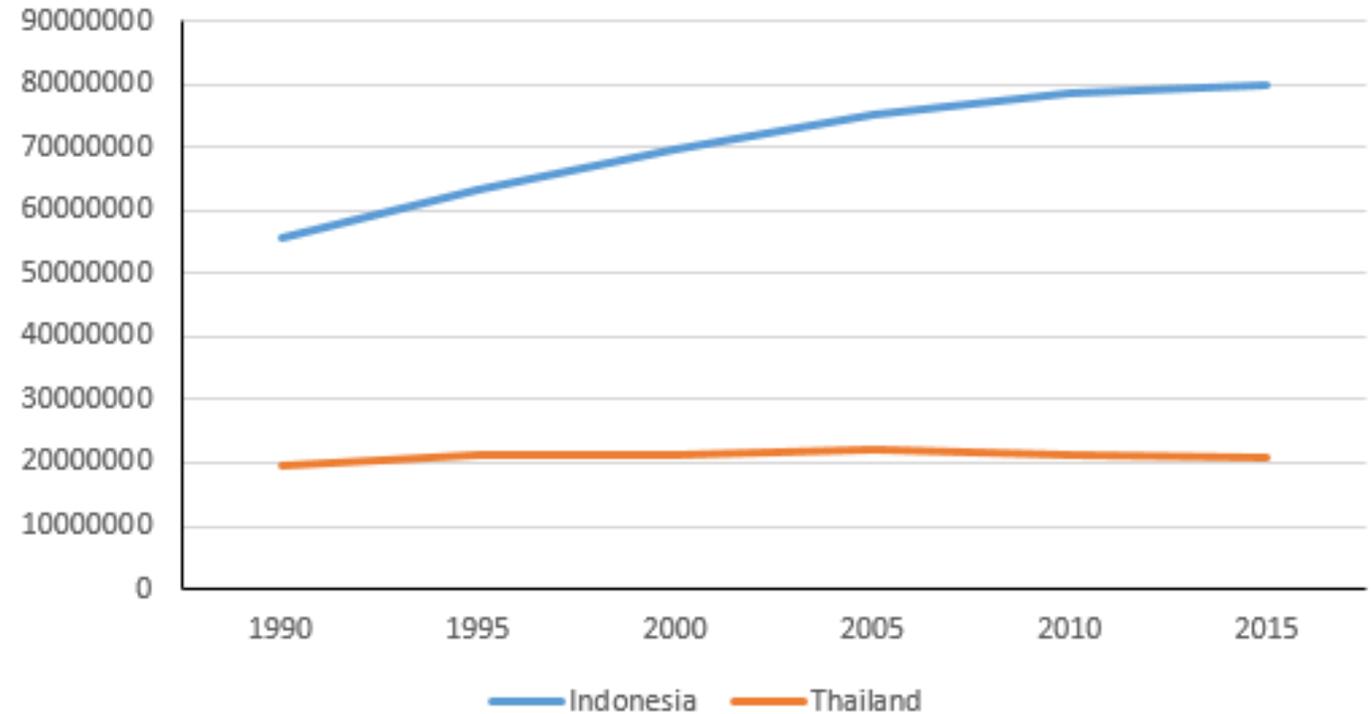
database/database-top.html

Year	Electricity consumption (in ktoe)	
	Indonesia	Thailand
1990	2.624	3.297
1991	2.945	3.698
1992	3.363	4.240
1993	3.701	4.840
1994	4.207	5.376
1995	7.065	6.125
1996	7.637	6.652
1997	8.390	7.089
1998	8.212	6.917
1999	10.301	7.005
2000	9.365	7.562
2001	9.795	7.937
2002	10.093	8.615
2003	10.481	9.198
2004	9.117	9.854
2005	9.205	10.387
2006	9.684	10.951
2007	10.435	11.413
2008	11.103	11.608
2009	11.584	11.587
2010	12.675	12.813
2011	13.749	12.759
2012	14.963	13.871
2013	16.129	14.185
2014	17.080	14.461

There are two sections of the worksheet: DESCRIBING DATA and INTERPRETING DATA.

INTERPRETING DATA

- 1 By looking at the graph, describe the differences and similarities between electricity consumption of Thailand and Indonesia.
- 2 The following are the population count of Indonesia and Thailand from 1990 to 2015.



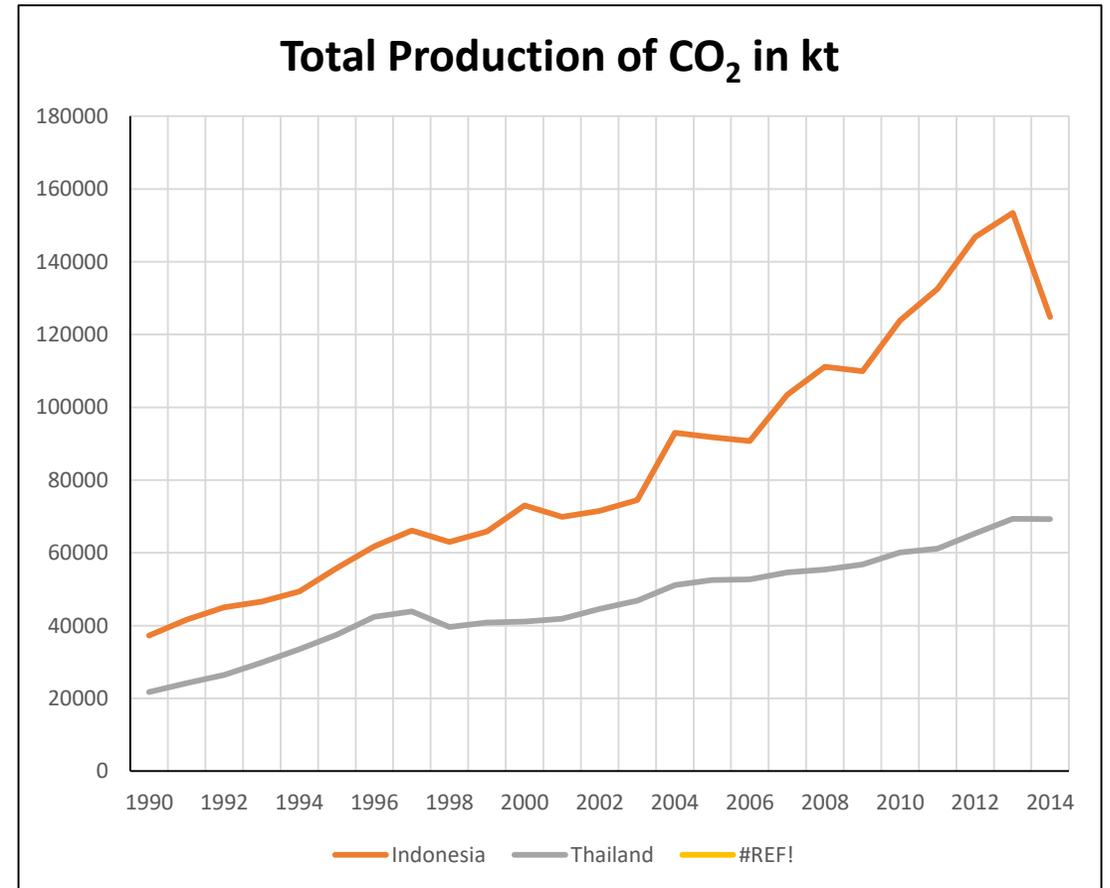
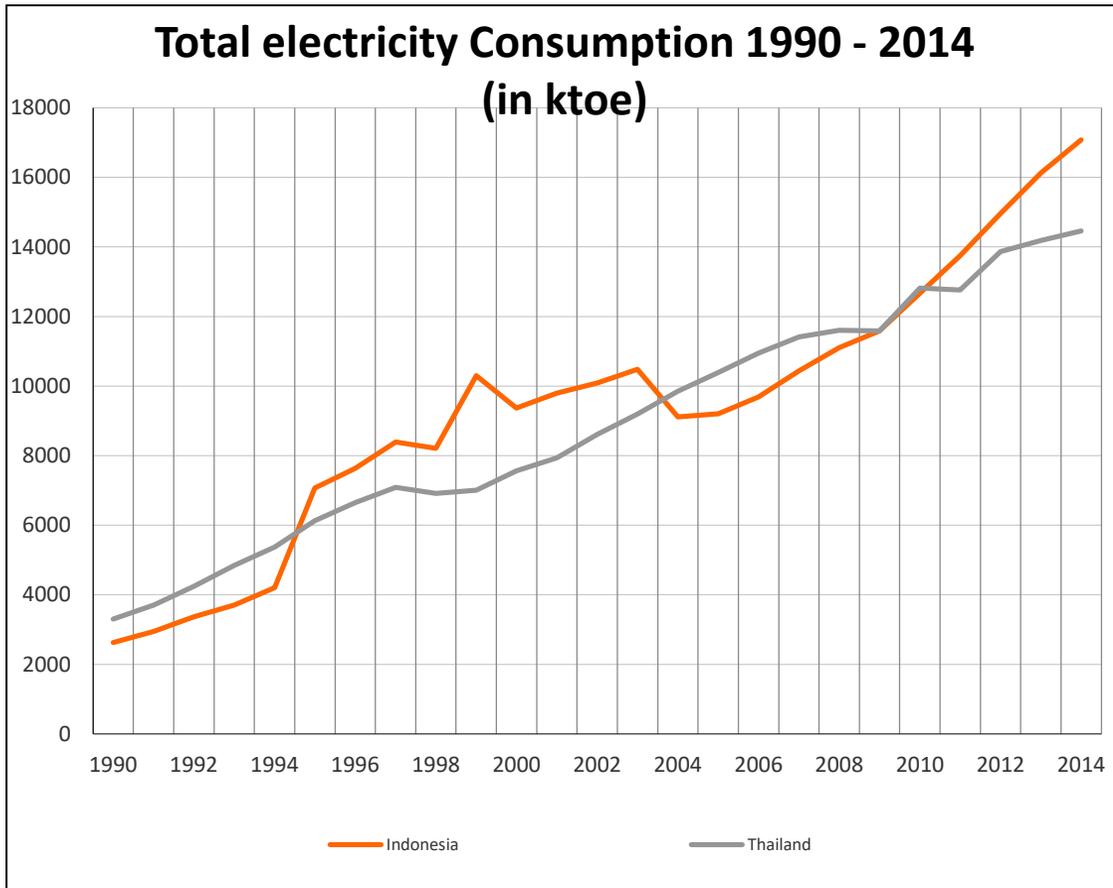
Source: www.gapminder.org/data/

- Do you agree that the consumption of electricity is related to the number of people living in the country? Explain your reason.
- 3 What do you think is the factor that influence the amount of electricity consumption of a country? Explain.

Worksheet 2

THE COST OF OUR BRIGHT WORLD

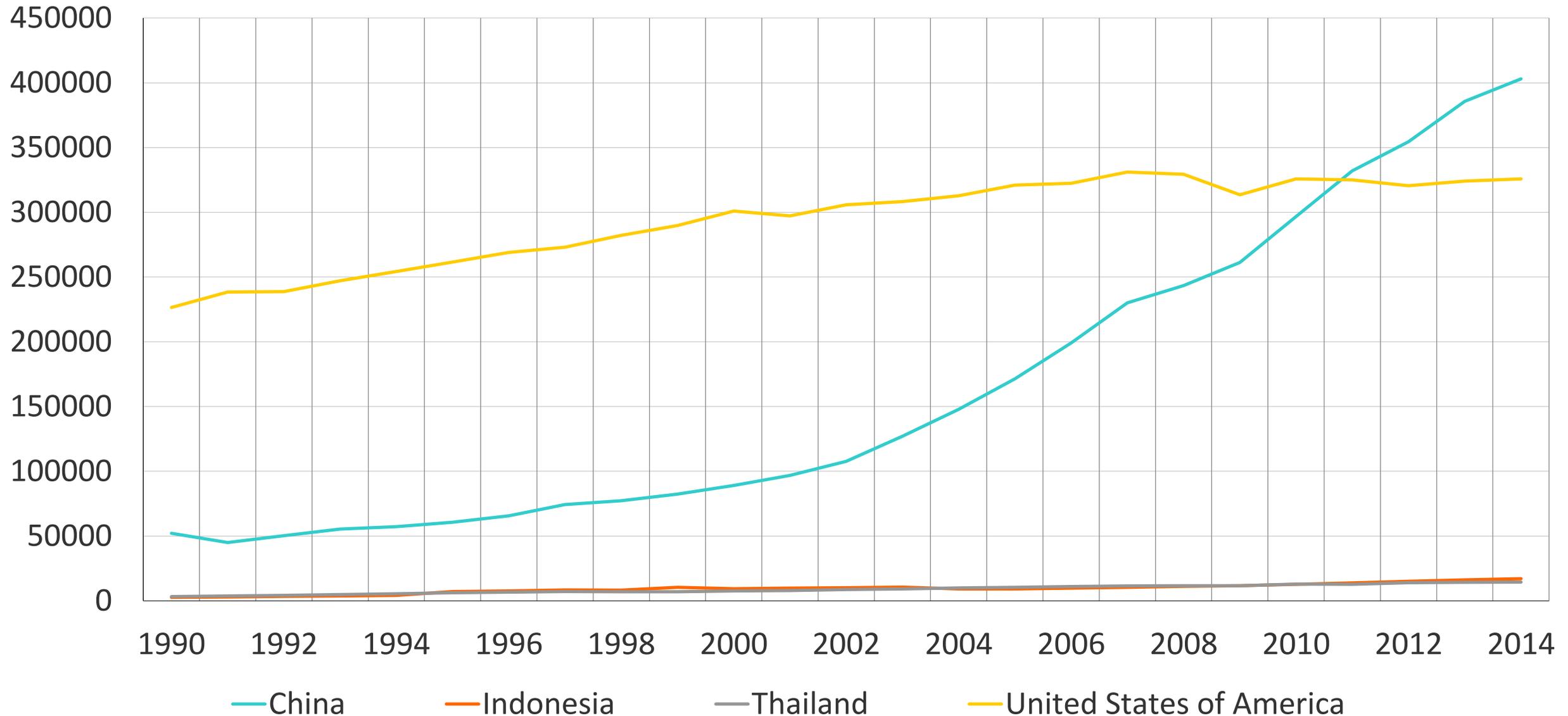
Does electricity consumption cause air pollution?



"Can you observe any relation between electricity consumption and production of CO₂?"

The students are going to investigate data from the following countries.

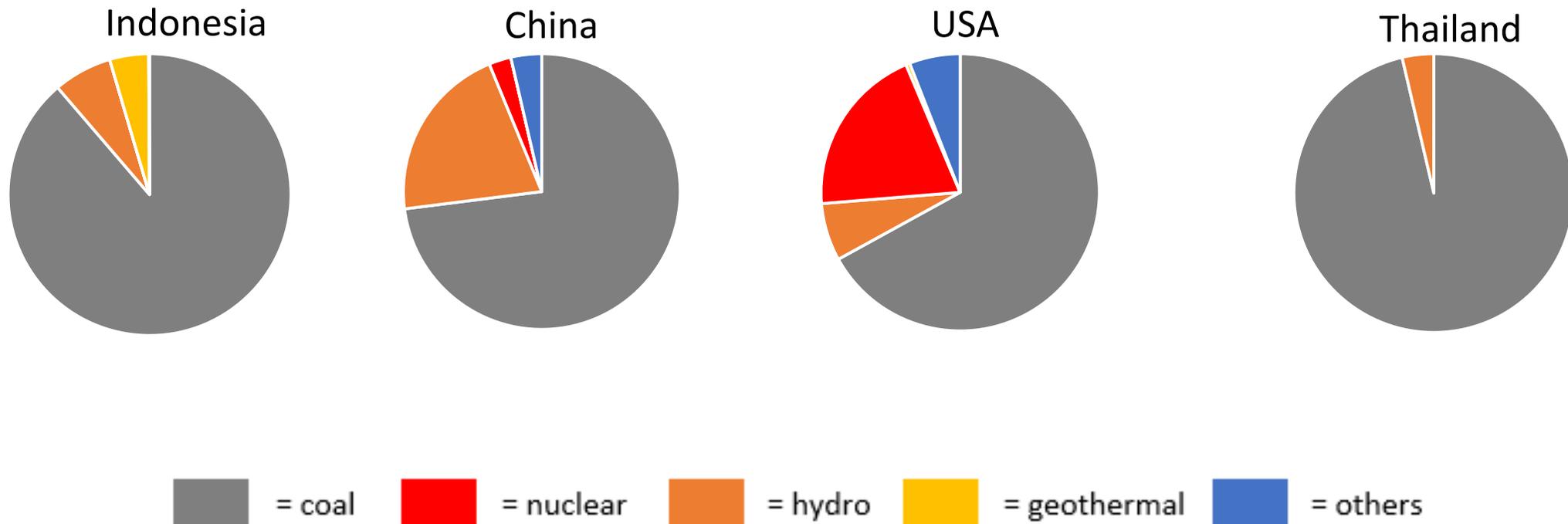


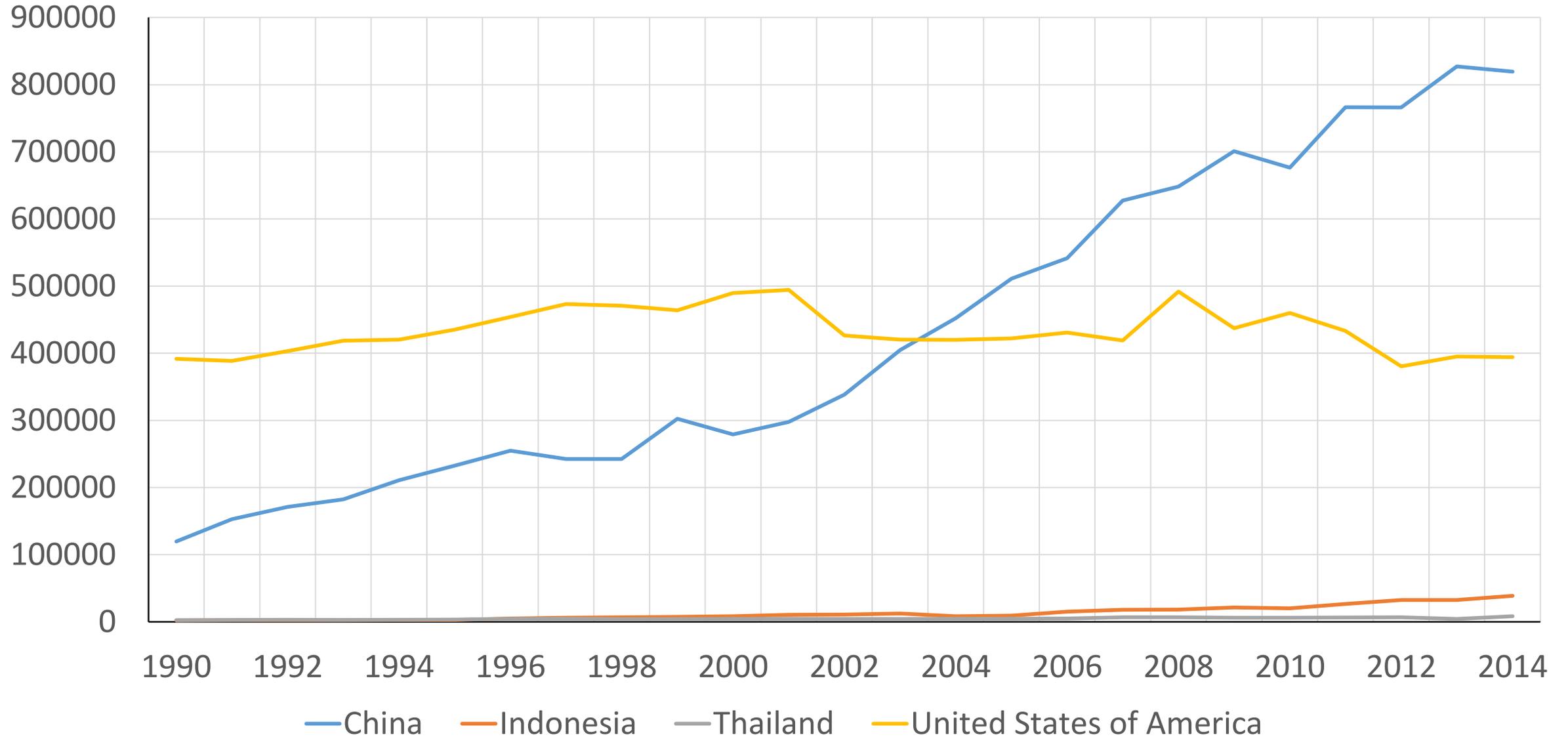
Graph 1**Total Electricity consumption 1990 - 2014 (in ktoe)**

Graph 2

SOURCE OF ENERGY TO CREATE ELECTRICITY

The following are pie charts depicting source of energy for electricity in 2014. What can you conclude?

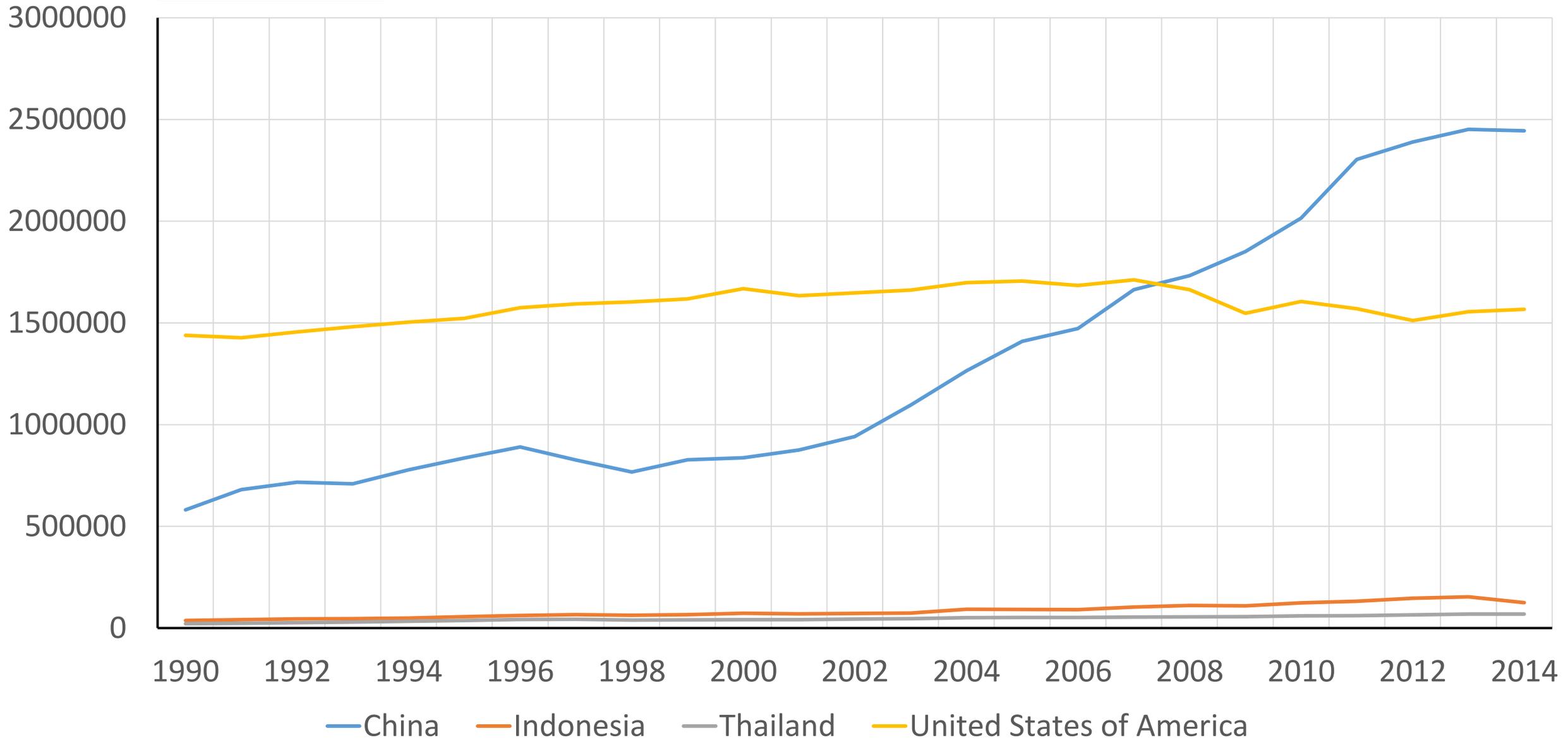


Graph 3**Coal Consumption for Power Generation (in ktoe)**

source: <http://www.egeda.ewg.apec.org/egeda/database/database-top.html>

Graph 4

Total CO₂ Emission in kt



source: <http://www.egeda.ewg.apec.org/egeda/database/database-top.html>

INTERPRETING DATA

- 1** Observe Graph 1. For China and USA, their electricity consumption is going up.

However, in Graph 4, CO₂ production of China is going up while USA's CO₂ production is going down.

What do you think is the cause behind these phenomenon? Explain your answer. Use the graph to support your reasoning.
- 2** Does higher electricity consumption influence higher CO₂ production? Explain your assumptions.

PHASE III: DO



OUR STUDENTS



34 grade 8
students from SMPN
(Junior High School) 4
Pakem



32 grade 8
students from
Demonstration School of
Khon Khaen University
(Mo Ding Dang)

LESSON DAY I

August 1, 2017



LESSON DAY 1

August 1, 2017



EXAMPLE OF STUDENTS' ANSWER: MEETING 1

Indonesian students

1. By looking at the graph, describe the difference and similarities between electricity consumption of Thailand and Indonesia.

Thailand is more stable than Indonesia.

- Do you agree that the consumption of electricity is related to the number of people living in the country? Explain your reason.

~~Yes~~ because No, I ~~don't~~ agree. It is ^{the} related to the technology of ~~this~~ country.

3. What do you think is the factor that influence electricity consumption of a country? Explain.

Technology and population are the factor that influence electricity consumption of a country.

- Do you agree that the consumption of electricity is related to the number of people living in the country? Explain your reason.

Yes, because people are depending on electricity nowadays, so ~~the~~ more people the more electricity consumption.

3. What do you think is the factor that influence electricity consumption of a country? Explain.

The factors of electricity consumption are

- The different temperatures
- Habits
- Appliance ~~consumption~~ and electronics
- Population

LESSON DAY 2

August 8, 2017



VIDEO: MEETING 2



EXAMPLE OF STUDENTS' ANSWER: LESSON DAY 2

2. Look at Graph 2.

Among all the primary sources of energy (coal, hydro, geothermal, nuclear, and others) which one is used the most by all the four countries?

Coal is used the most all countries

4. Look at Graph 4.

- Describe the similarity and difference in CO₂ emission of China and USA.
- What can you say about CO₂ emission of Thailand and Indonesia?

a. Similarity: Both China and USA produce high emissions
difference: China, it is increasing while in USA, it mostly stays the same
b. CO₂ emission of Thailand and Indonesia are very low

1. Observe Graph 1. For China and USA, their electricity consumption is going up.

However, in Graph 4, CO₂ production of China is going up while USA's CO₂ production is going down.

What do you think is the cause behind these phenomenon? Explain your answer. Use the graph to support your reasoning.

Because China use more coal than USA. and USA have another alternative energy, for example they use nuclear, hydro, and others. So it can reduce CO₂ production because these are have less emission.

Does higher electricity consumption cause higher CO₂ production? Explain your answer.

No, depend to source energy that use to create the electricity
it doesn't

PHASE IV: REFLECT



REFLECTION

- The students were enthusiastic and greatly enjoyed the lesson. They can understand the world through mathematics lesson by investigating real life, raw data from reliable sources.
- The lesson opens the possibility for the use of ICT which is completely new to Indonesian education: connectivity.
- The study needs to be implemented in more than one cycle to accommodate the revision.

REFLECTION

- Internet connection was a big obstacle.
- Even though most of the time teachers and students can speak English well, sometimes words are hard to comprehend due to internet connection.
- Recording the sound of the room makes it hard to understand through internet.

SUGGESTION FOR THE NEXT LESSON STUDY:

- For internet, it is recommended to use LAN/cable connection.
- The broadcast should be provided with subtitles.
- It is recommended that instead of recording the sound of the room, the microphone should be connected through the internet instead.

WHAT DO THE STUDENT THINK?

*What did they like about the lesson?
What do they want to improve from
the lesson?*





Thank you.