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# Comparative Study on Energy Consumption in the Asian Landlocked Countries

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# Background

As the ASEAN emerges as a hub of the global economy, this region consumes energy more.

The international energy agency (IEA) predicted that the ASEAN's energy demand will grow by 80% from 2015 to about 46EJ (1100 Mtoe) in 2040, accompanying with the regional economic development [*].

[*] IEA (2015) *Energy demand prospects*. In: Southeast Asia energy outlook 2015

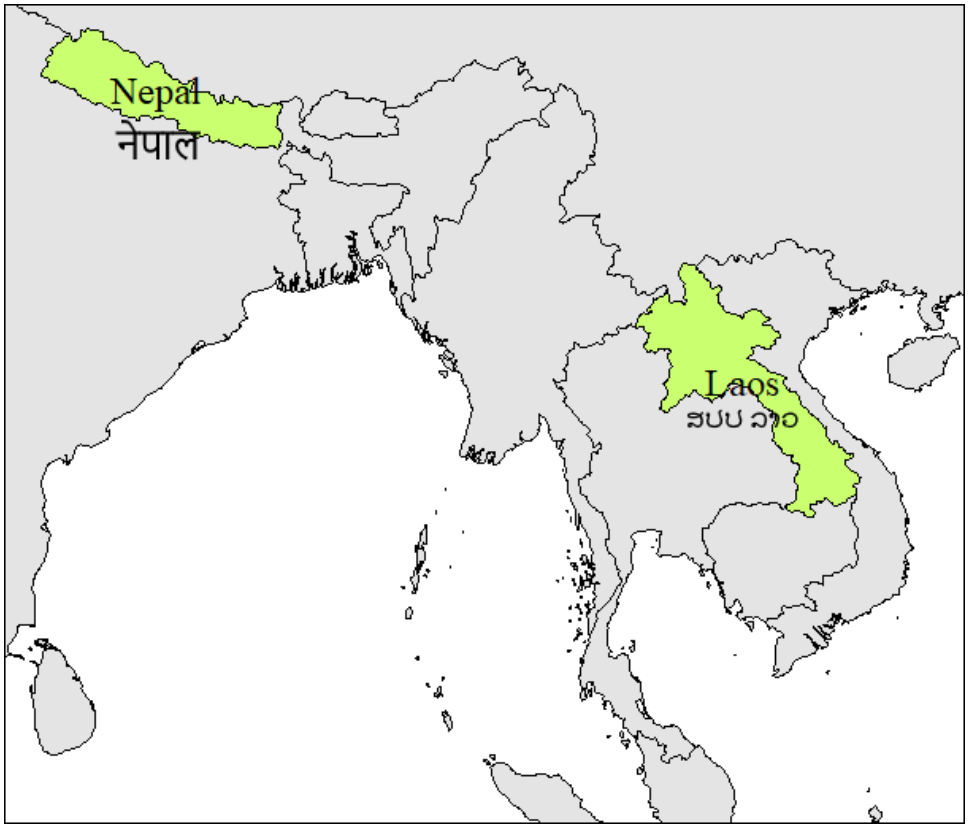
Recently I focus on the increase in the residential energy consumption in the least developed countries such as Cambodia, Laos, Nepal

,and Myanmar

# Background

Laos and Nepal are the least developed countries (LDCs) and share many similarities in terms of geographical and socio-economic features.

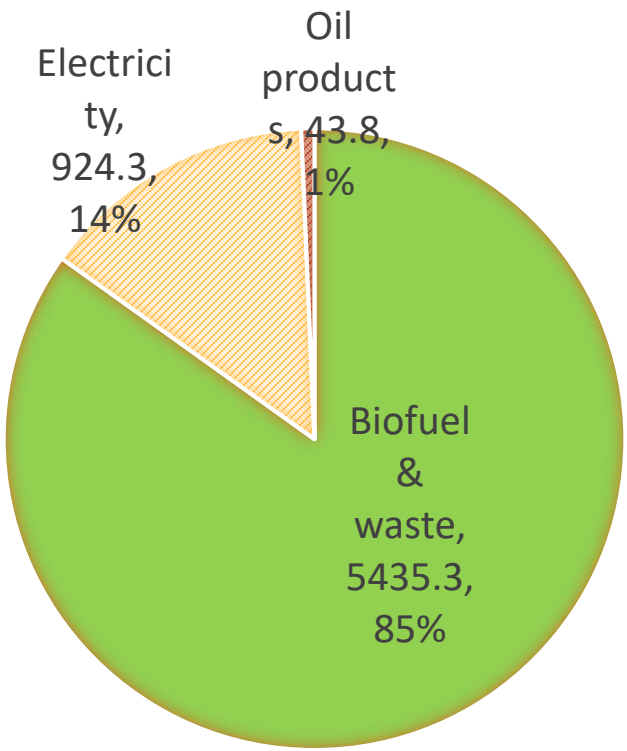
- Large parts of their territories belong to massifs
- Rich in water resources
  - ✓ hydroelectric dams are thus the main source of electricity
- Multi-ethnic societies
- Easily influenced by the neighboring superpowers




However, energy use, especially electricity use, is very different.

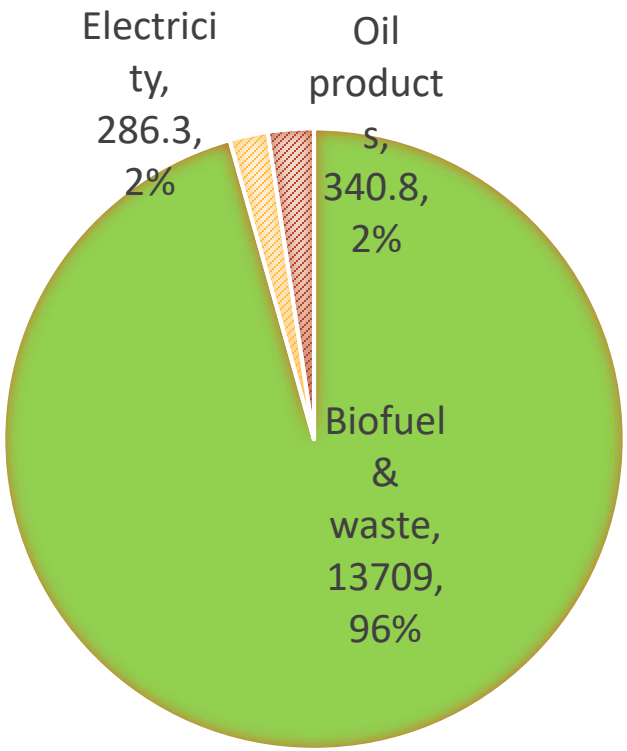
# Residential Energy Consumption of Laos and Nepal (2016)

LAOS




Unit [MJ / capita / annum]

NEPAL




Unit [MJ / capita / annum]

The traditional biofuels (firewood and charcoal) and waste (agricultural residue, etc.) are prime energy sources in the residential sector in these countries.

# Biofuels vs. Electricity

The larger share of biofuels has caused a social problem;

- Example: Nepali women bear a huge burden of collecting firewood in addition to the other household-related works

Increasing electricity use is one of the solutions to this problem;

- A Nepali said that “when electricity is introduced into the household, it is definitely women that benefit the most

However, there is the large difference in electricity use in Laos and Nepal.

The residential electricity consumption
(per capita per annum)

| Laos | | Nepal |
|---|---|---|
| 256.8kWh (924.3 MJ) | > | 79.5kWh (286.3 MJ) |

Nepal is way behind in the in the residential electricity use.

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# Research questions

1. What causes the difference in the residential electricity consumption between Laos and Nepal?

To discuss whether this difference can be resolved or not, *i.e.*, whether Nepal will catch up with Laos in the near future in terms of residential electricity use, is the second motivation.

2. Can Nepal catch up with Laos in terms of residential electricity use?

# Hypotheses

1. Economic disparity between Laos and Nepal relates the difference in the residential electricity consumption
2. Economic development causes the increase in the residential electricity consumption.

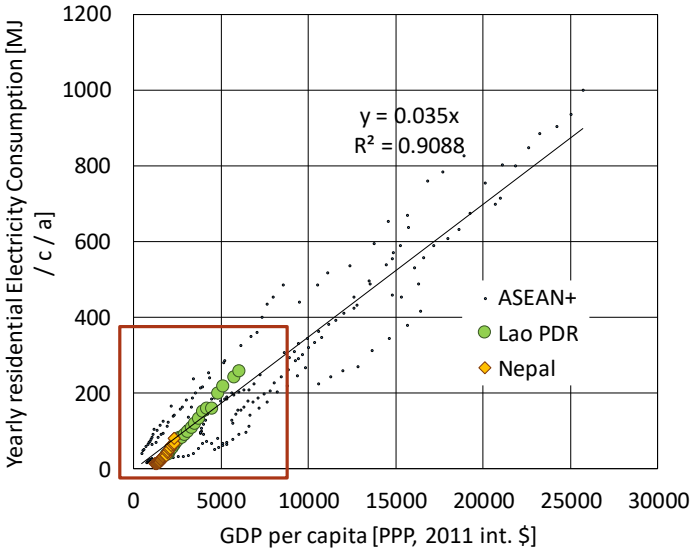
If the Hypothesis 1 and 2 are proved, the Question 1 is clearly answered;

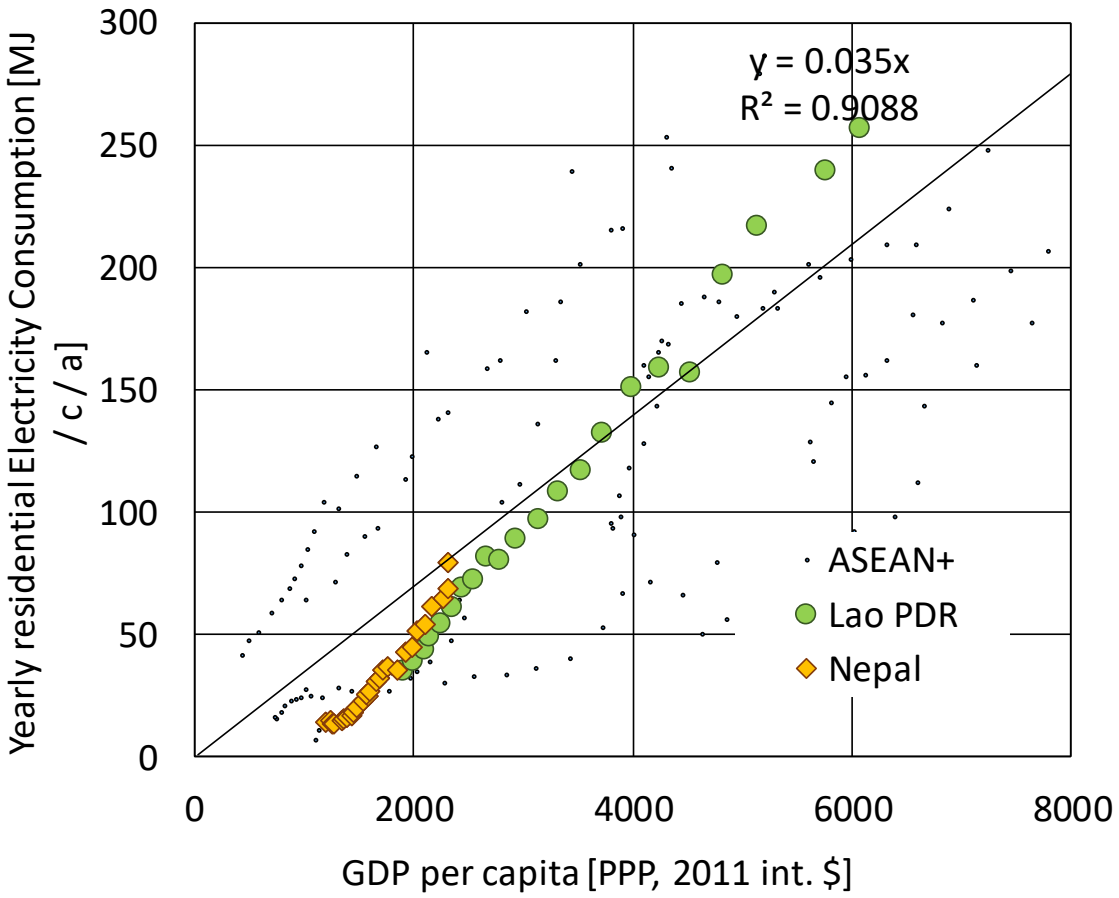
- *i.e.*, the economic growth is thought to be the main cause to increase the residential electricity consumption.

If so, the Question 2 is easy to be answered;

- *i.e.*, Nepal can catch up with Laos in terms of residential electricity use when the level of economic development reaches to that of Laos.

# Correlation between economic growth and electricity consumption



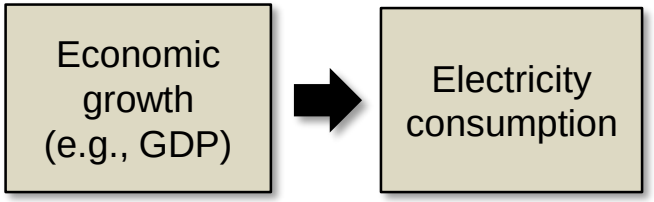




- Strong linear correlation between the GDP per capita and residential electricity consumption among ASIAN countries
- The Lao and Nepali data follow this linear relationship
- This tells that the Hypothesis 1 is correct.

# Granger causality between economic growth and electricity consumption

The result of the Granger causality test indicates that the economic development "granger-causes" the residential electricity consumption in Laos and Nepal at the 0.1 level of significance.

Therefore, a simple causal model is acceptable for Laos and Nepal




Simple causal model

The result of the Granger causality test tells that the Hypothesis 2 is correct.

So, the Question 2 is simply answered:

- Nepal can catch up with Laos in terms of residential electricity use when the level of economic development reaches to that of Laos.

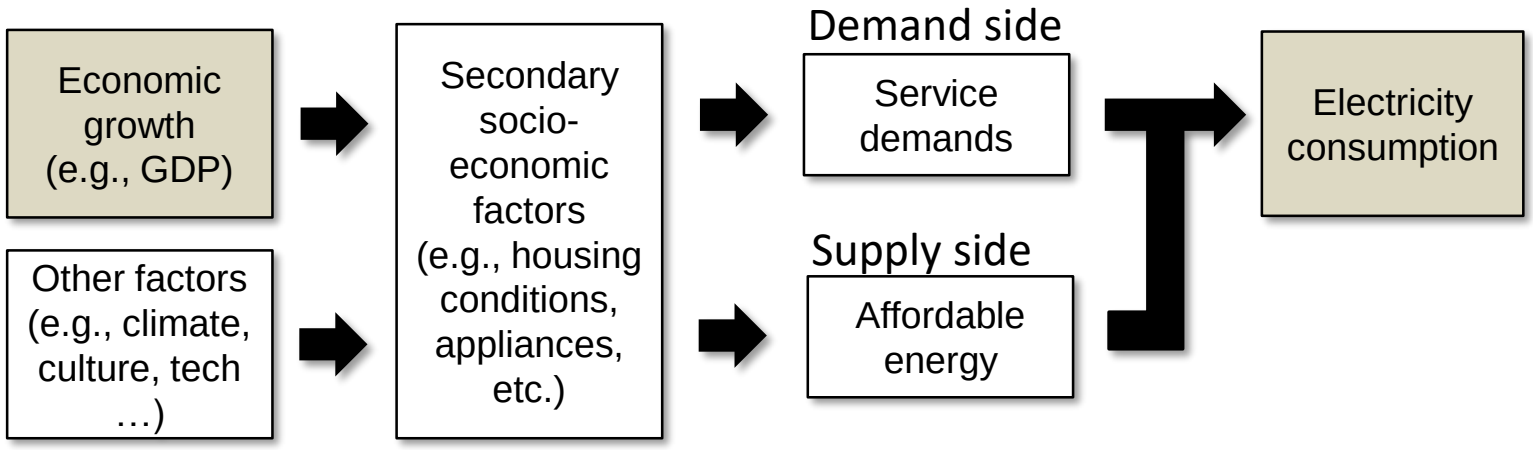
# Detailed consideration on the relationship between the economy and electricity consumption

Now I said that:

- Nepal can catch up with Laos in terms of residential electricity use when the level of economic development reaches to that of Laos

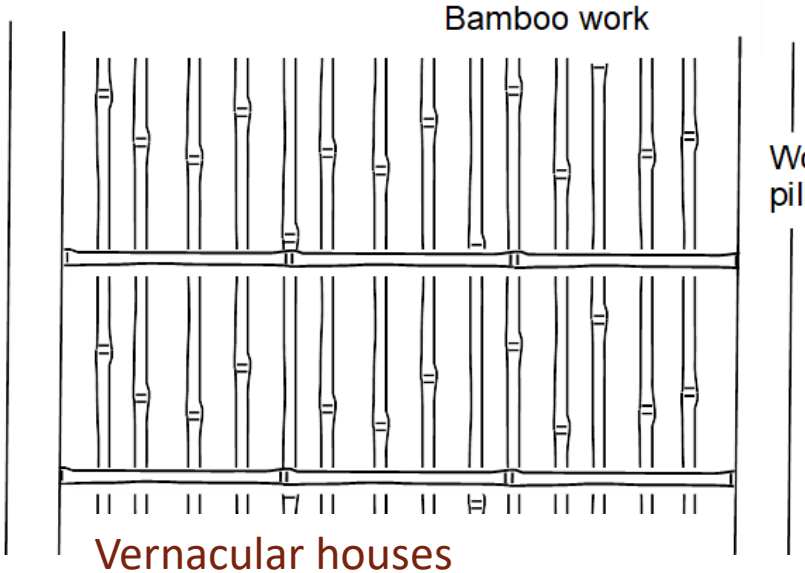
However, we must be careful to conduct a prediction of future energy consumption

We need a detailed consideration on the mechanism of interaction between the economic development and electricity consumption



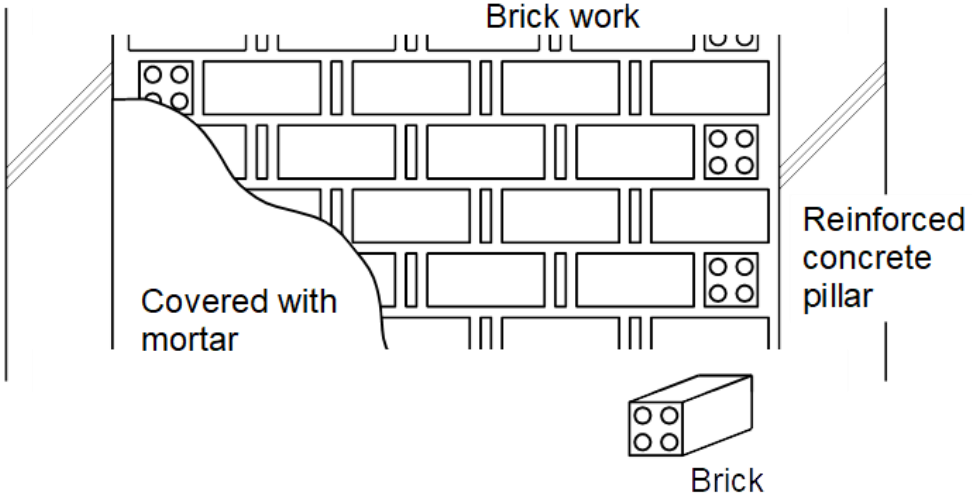

Expanded causal model

# Shift from vernacular architecture to modern one



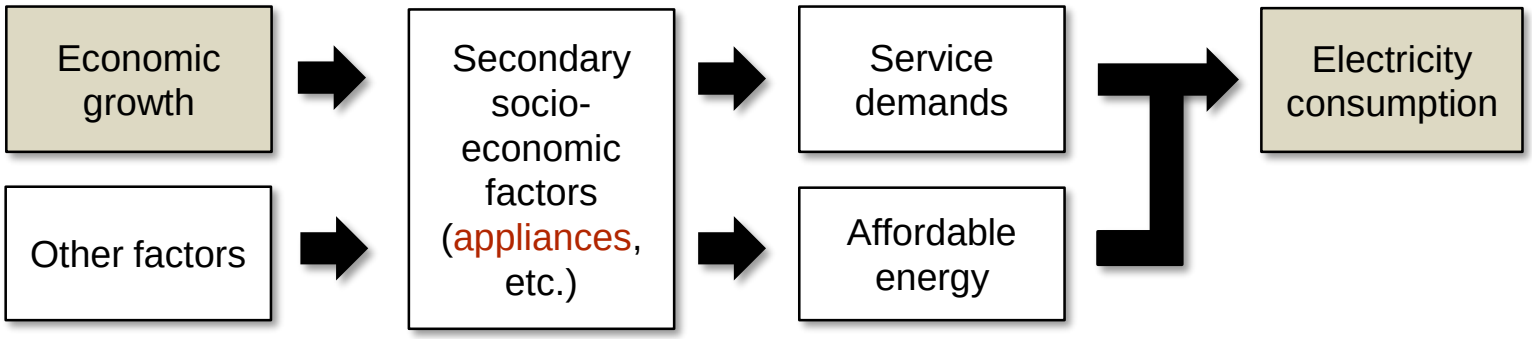

Vernacular houses
Soft/temporary wall materials:
Durability: low
Ventilation: good

Modernizes houses
Hard/permanent wall materials:
Durability: high
Ventilation: bad

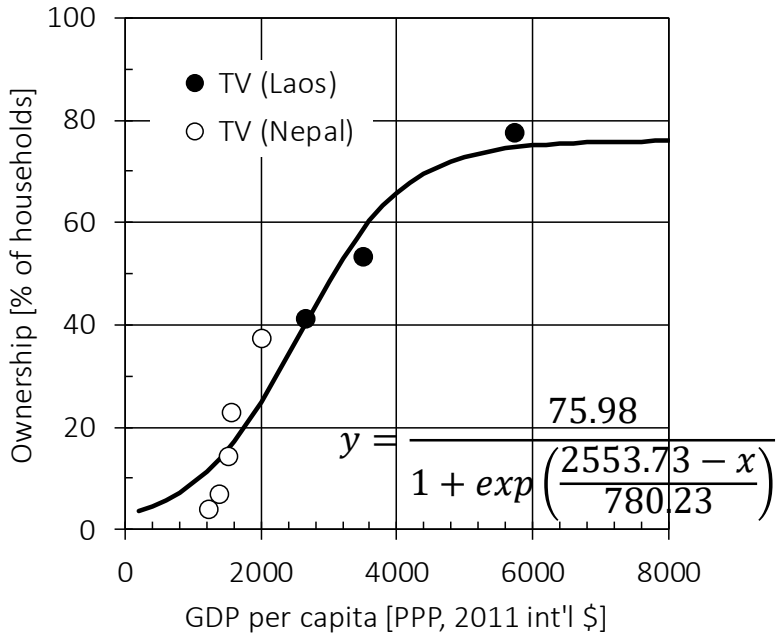



- The shift from climate-responsive vernacular houses to climate-irresponsive modernized houses leads to the potential for increase the energy for maintaining thermal comfort by artificial measures

# Possession of durable home appliances

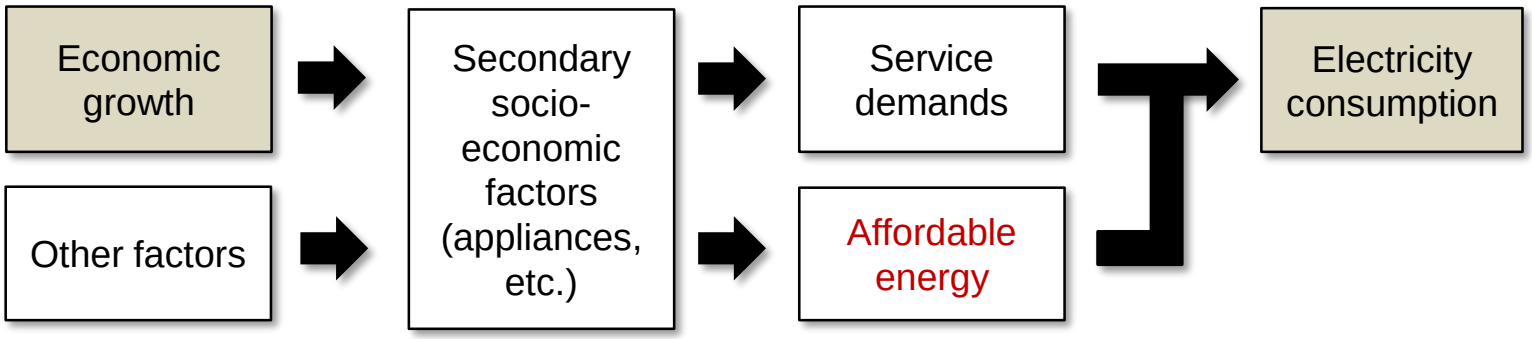



- The growth pattern of the Nepali TV ownership seems to trace that of Laos
- A logistic curve is superimposed as a result of the logistic regression by using both countries' data
- Economic growth may increase the ownership of the home appliances
- The increase in ownership of the home appliances increases the residential electricity consumption

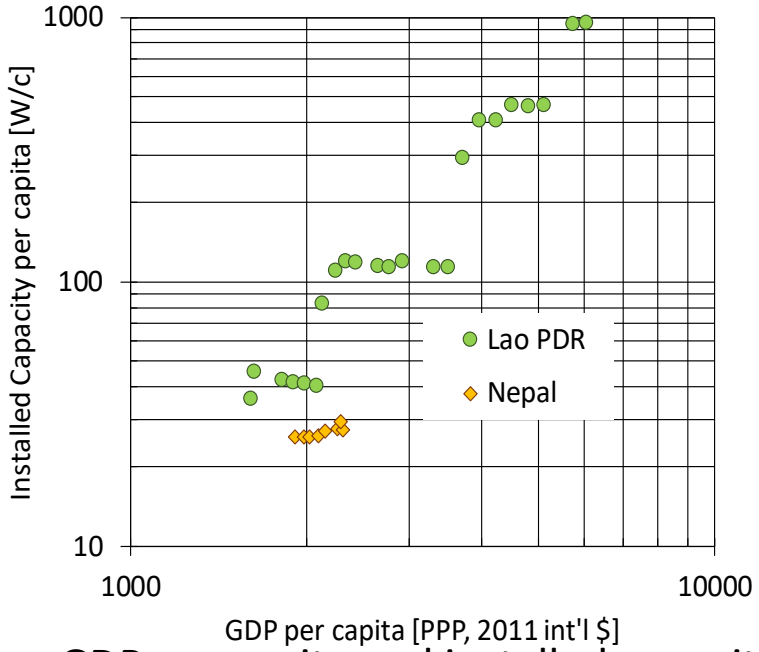



TV ownership with the GDP per capita

# Affordable energy




- The Lao installed capacity per capita increases accordingly with the growth of the GDP per capita
- Nepal is way behind in the installed capacity per capita as compared with Laos
- The limitation of installed capacity has potential for the restriction of residential electricity use




GDP per capita and installed capacity of electric power plants per capita

# Conclusions

The regression analysis and the Granger causality test shows that there is linear and causal relationship between the economic growth and residential electricity consumption in Laos and Nepal

Nepal can catch up with Laos in terms of residential electricity use when the level of economic development reaches to that of Laos if the linear relationship between the economy and electricity continues

However, a detailed consideration on the indicators linking the economic development and electricity consumption draws attention to the fact that:

- Nepal is way behind in the installed electricity generation capacity per capita as compared with Laos

The limitation of generation capacity may suppress the growth of the residential electricity use in Nepal in the near future despite of the high access to electricity and their abundant water resources.