# GLOBAL WARMING: Natural Science versus Social Sciences Issues

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**Abstract**

It is true that climate change and its implications are given much more attention now, after the COP21 Agreement in Paris. There are almost weekly conferences about global warming and the debate is intense all over the globe. This is a positive, but one must point out the exclusive focus upon natural science and technological issues, which actually bypasses the thorny problems of international governance and the coordination of states. The social science aspects of global warming policy-making will be pointed out in this article. This is a problematic by itself that reduces the likelihood of successful implementation of the goals of the COP21 Agreement (Goal I, Goal II and Goal III in global decarbonistion).

**Keywords:** Decarbonisation, natural sciences and social sciences issues, Wildavsky model, Kaya model, GDP-CO2(GHC) link, energy mix in various countries, Super fund.

## Introduction

### I. Natural Science Issues

It seems that the key issues in the global climate change debate concerns *inter alia* the following:

1. What more precisely is the link between the amount of carbon in the atmosphere and the rise of temperature, in sea and n land? Is it a linear or non-linear link? Thresholds? Reversibility?
2. How and when will rising temperatures in sea and at land affect basic environmental aspects, like the ice layers and the frozen waters as well as glaciers?
3. How much carbon will be stocked in the atmosphere in this century, given alternative scenarios of emissions and natural carbon uptake? How dangerous could increasing GHG:s like methane be?
4. Is it at all feasible to accomplish massive decarbonisation of the air by means of carbon sequestration at what costs?

Having full knowledge about all these issues would improve much upon the theories of global warming and would be extremely useful in practice when policies are to me made about decarbonisation.

Yet, they do not comprise the implications of lessons of the social sciences for global governance, coordination and policy making. The crux of the matter is what I call the *Wildavsky hiatus*: policies however appealing are bound to fail when put in practice, as no policy is self-implementable (Pressman and Wildavsky, 1973, 1984). To grasp the feasibility of the COP21 project and its three goals of decarbonisation, one must understand the implementation deficit and the coordination failures. I will spell out these concepts here in relation to the COP21 framework, and its three objectives, namely:

a) Halting the increase in carbon emission up to 2020 (Goal I);
b) Reducing CO2:s up until 2030 with 40 per cent (Goal II);
c) Achieve more less total decarbonisation until 2075 (Goal III).

It is up to the governments of the countries to implement these goals with rather weak overview from international governance but with the promise of assistance from a huge Super Fund. What, then, are the *incentives* involved in decentralised decarbonisation a la COP21? To discuss decarbonisation feasibility along the three goals – Goal I, Goal II and Goal III – one need to take into account the restrictions on human action and interaction in social systems, spelled out in economic theory and game theory

## II. Basic Economic Issues

The basic theoretical effort to model the greenhouse gases, especially CO2:s, in terms of a so-called identity is the deterministic Kaya equation. The Kaya identity, "I = PAT" – model type, describes environmental (I)mpact against the (P)opulation, (A)ffluence and (T)echnology. Technology covers energy use per unit of GDP as well as carbon emissions per unit of energy consumed (Kaya and *Yokoburi*, 1997).

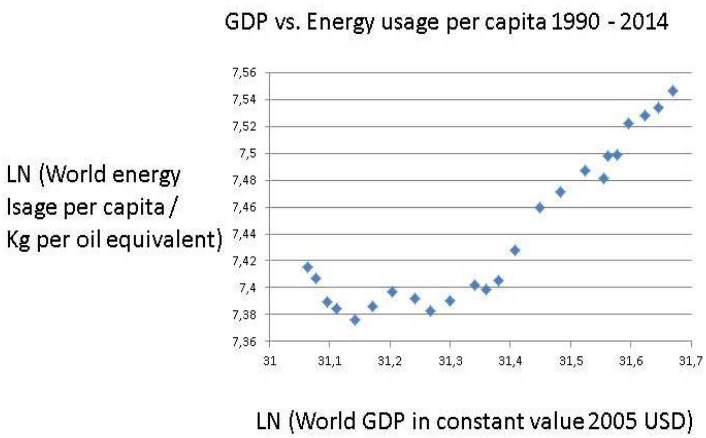
In theories of climate change, the focus is upon so-called anthropogenic causes of global warming through the release of greenhouse gases (GHG). As energy is the capacity to do work, it is absolutely vital for the economy in a wide sense, covering both the official and the unofficial sides of the economic system of a country. The best model of carbon emissions to this day is the so-called Kaya model. It reads as follows in its standard equation version – *Kaya's identity* linking carbon emissions on changes in population, economic activity as GDP per, energy intensity and carbon intensity of energy. It is appropriate to formulate it as a stochastic law-like proposition, where coefficients will be estimate using various data sets. Thus, we have this equation format for the Kaya probabilistic law-like proposition, as follows:

(E1) Multiple Regression: $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + ... + b_tX_t + u$
Note: Y = the variable that you are trying to predict (dependent variable); X = the variable that you are using to predict Y (independent variable); a = the intercept; b = the slope; u = the regression residual.
Note: http://www.investopedia.com/terms/r/regression.asp#ixzz4Mg4Eyugw
I make an empirical estimation of this probabilistic Kaya model - the cross-sectional test for 2014:
(E2) k1= 0,68, k2=0,85, k3=0,95, k4=0,25; $R^2$ = 0.885.
Note: LN $CO_2$ = k1*LN (GDP/Capita) +k2*(dummy for Energy Intensity) + k3*(LN
Population) + k4*(dummy for Fossil Fuels/all) Dummy for fossils 1 if more than 80 % fossil fuels; k4 not significantly proven to be non-zero, all others are. (N = 59)

The Kaya model findings show that total GHG:s go with larger total GDP. To make the dilemma of energy versus emissions even worse, we show in Figure 1 that GDP increase with the augmentation of energy per capita. Decarbonisation is the promise to undo these dismal links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy.

**Figure 1.** GDP against energy per person (all countries)

Economic development in poor countries as well as economic growth




in advanced countries tends to trump environmentalism. This sets up the energy-emissions conundrum for mankind in this century: Affluence requires energy, as energy is the capacity to do work that renders income; but as energy consumption augments, so do emissions of GHG:s or $CO_2$:s. How to fundamentally transform global energy consumption?

## III. Framework Of Analysis Of Decentralised Decarbonisation

We need to model this energy-emission dilemma for the countries of the COP21 project. To understand the predicament of Third World countries, we need to know whether GHC:s or CO2:s are still increasing (Goal I) and what the basic structure of the energy mix is (Goal II). Thus, I suggest:

<GDP-GHG(CO2) link, energy mix>,

as a model of the decarbonisation feasibility in some Third World countries, to be analysed below, following the so-called ”Kaya” model. The first concept taps the feasility of Goal I: halting the growth of GHG:s or CO2:s, whereas the other concepts targets the role of fossil fuels and wood coal like charcoal.

The difference between global warming concern and general environmentalism appears clearly in the evaluation of atomic power. For reducing climate change, nuclear power is vital, but for environmentalism atomic power remains a threat. From a short-term perspective, the global warming concerns should trump the fear of radioactive dissemination, as global warming will hit mankind much sooner. In the Third World, nuclear power plants are increasing in number, whereas in the mature economies their number is being reduced. New nuclear technology is much safer, why also advanced countries should use this option, like for instance the UK.

Just because there is an agreement it does not entail it will be respected.

Even if respecting the promises made is the best strategy for all partners to the dal, each individual has an incentive to renege upon the agreement. In two-person game theory, a few much discussed models portray coordination failures, and they are applicable to governments as well as international governance. If, as shown above with the Kaya model, decarbonisatin may be costly, hurting economic development, then perhaps a country may simply go its own way, leaving it up to the other(s) to handle the externalities in global warming. Why make costly contributions to collective action? Remember that small countries do not matter much (N-1 problematic) and huge countries would have to share the benefits with all others (I/N problematic).

The interaction between nations and their governments can be of two kinds: zero sum game or variable sum game. Halting the climate change process constitutes a Pareto optimal goal for all participants with means of collective action, coordination either by themselves or with a third party, an international governance body like that of the UNFCCC. However, coordination may fail to reach a set of Pareto optimal outcomes, as the choice participants chose Pareto inferior strategies due to self-interest seeking with guile. Coordination failures arise when individual rationality prevails over collective rationality: Reneging (PD game), Threat (Chicken

game), Sub-optimality (Negotiation game) and Second best solutions (Assurance game).
We will give some examples of these possible coordination failures in the management of the global warming process, where also financial help from a Super Fund enters the gaming strategies.

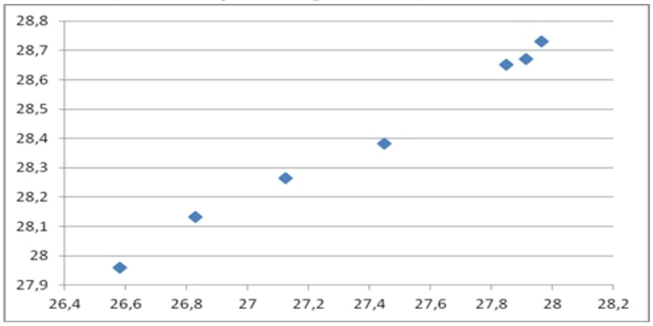
## IV. Comparative Country Enquiry

I will analyse a few important countries in a comparative fashion so that they can be compared systematically. Two diagrams will be presented for each country, related to the research approach above. First, the COP21 Goal It will be tapped by looking at the curve between GDP and CO2:s (GHG:s), whether is rising or declining and whether it slopes outward or inward. Second, the COP21 Goal II is enquired into, as the energy consumption mix is portrayed: the more reliance upon fossil fuels and charcoal, the more costly the energy transition. What matters in both diagrams are both absolute and relative numbers. Thus, the coal share of energy resources may go down, but if total energy consumed is up, emissions will remain at a high level.
A set of countries with huge population at a low level income per person will find the COP21 objectives too exigent. They have to plan for more of energy in order to strengthen economic development against widespread poverty amidst string population growth. These countries can only promote Goal I and Goal II, if supported by the Super Fund.

### A. Poor Huge Nations

India
India will certainly appeal to the same problematic, namely per capita or aggregate emissions. The country is more negative than China to cut GHG emissions, as it is in an earlier stage of industrialization and urbanization. Figure 2 shows the close connection between emissions and GDP for this giant nation.

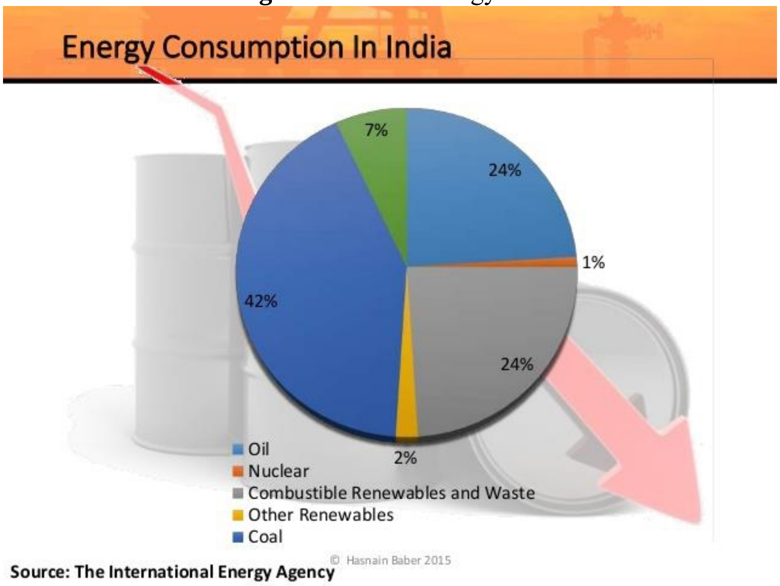
**Figure 2**. INDIA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)




Note: GHG = y-axis, GDP = x-axis

India needs cheap energy for its industries, transportation and heating (Figure 3) as well as electrification. From where will it come? India has water power and nuclear energy, but relies most upon coal, oil and gas as power source. It has strong ambitions for the future expansion of energy, but how is it to be generated, the world asks. India actually has one of the smallest numbers for energy per capita, although it produces much energy totally. Figure 3 shows its energy mix where renewables play a bigger role than in for instance China.

**Figure 3.** India's energy mix

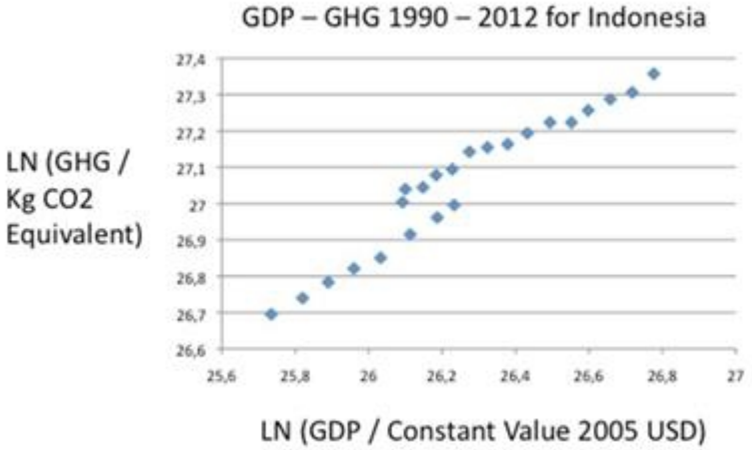



India needs especially electricity, as 300 million inhabitants lack access to it. The country is heavily dependent upon fossil fuels (70 per cent), although to a less extent than China. Electricity can be generated by hydro power and nuclear power, both of which India employs. Yet, global warming reduces the capacity of hydro power and nuclear power meets with political resistance. Interestingly, India uses much biomass and waste for electricity production, which does not always reduce GHG emissions. India's energy policy will be closely watched by other governments and NGO:s after 2018.

Indonesia

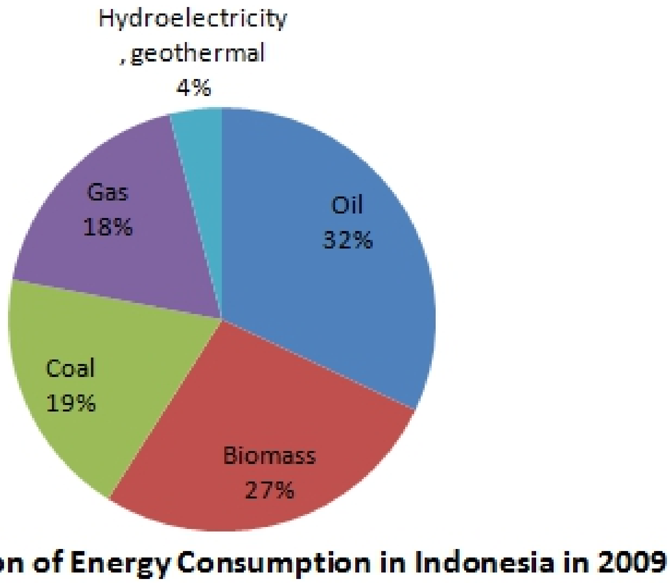
One may guess correctly that countries that try hard to "*catch-up*" will have increasing emissions. This was true of India. Let us look at three more examples, like e.g. giant Indonesia – now the fourth largest emitter of GHG:s in the world (Figure 4).

**Figure 4.** INDONESIA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)




Indonesia is a coming giant, both economically and sadly in terms of pollution. Figure 4 reminds of the upward trend for China and India. However, matters are even worse for Indonesia, as the burning of the rain forest on Kalimantan and Sumatra augments the GHG emissions very much. Figure 5 presents the energy mix for this huge country in terms of population and territory.

**Figure 5.** Indonesian energy (http://missrifka.com/energy-issue/recent-energy-status-in-indonesia.html**)**

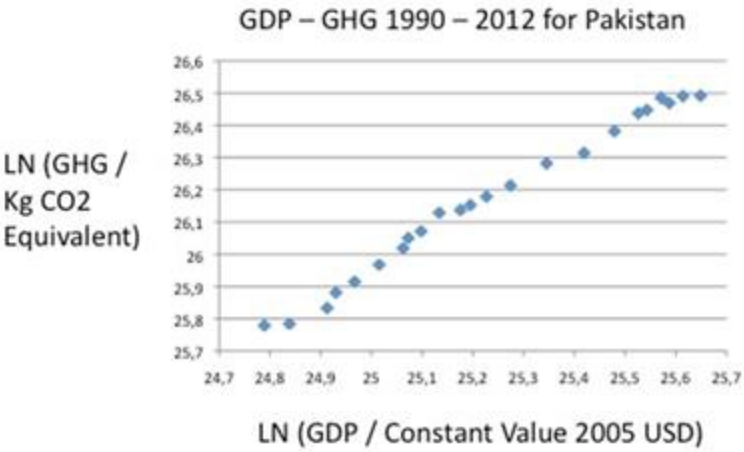



Only 4 per cent comes from hydro power with 70 per cent from fossil fuels and the remaining 27 per cent from biomass, which alas also pollutes.

Pakistan

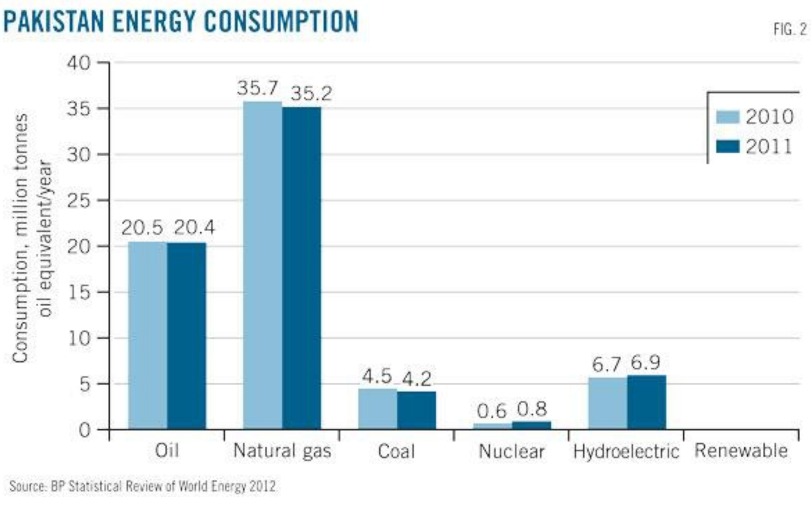
The same upward trend for emissions holds for another major developing country with huge population, namely Pakistan (Figure 6).

**Figure 6.** PAKISTAN: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)




The amount of GHG emissions is rather large for Pakistan, viewed on aggregate. Pakistan is mainly reliant upon fossil fuels (Figure 7).

**Figure 7.** Pakistan's energy mix

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But Pakistan employs a considerable portion of hydropower – 13 per cent – and a minor portion of nuclear power, which is a positive.

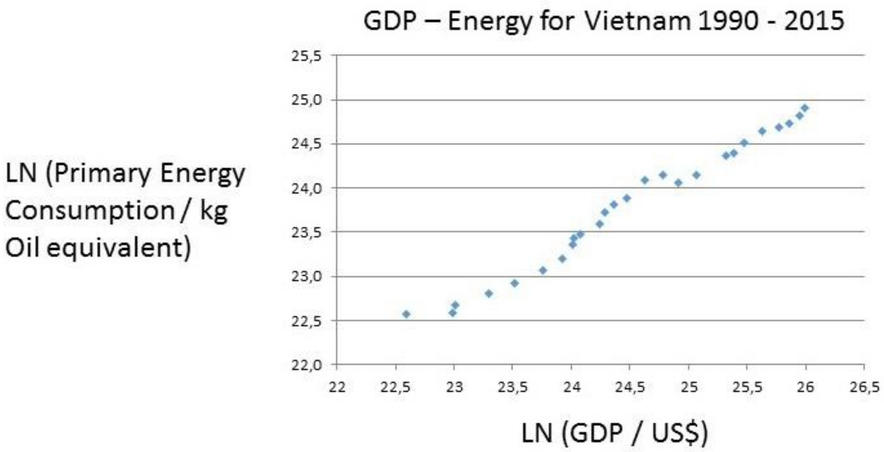
Vietnam

To further substantiate the argument about the CO2-energy conundrum that countries all over the world face, we may look at two populous nations in Asia with quickly expanding economies: Vietnam and the Philippines. They have both upward sloping trends for emissions, energy consumption and GDP, as the Kaya model entails.

Vietnam is now the perhaps most dynamic economy in Asia, after years of socialism and a planned economy. Such fast economic growth requires one thing especially, namely energy (Figure 8).

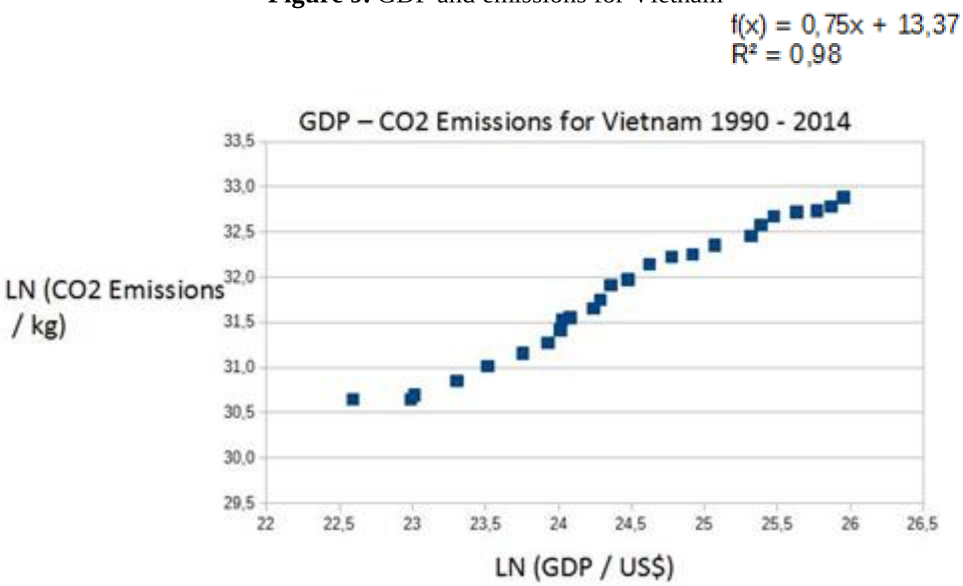
**Figure 8.** Vietnam: GDP and energy (y = 0,74x; $R^2$ = 0,98)

Here we see the most often occurring link between economic development and total energy consumption. The benefits of such a strong economic




development is of course raising affluence and diminishing poverty. But the costs involve much more emissions (Figure 9).

**Figure 9.** GDP and emissions for Vietnam



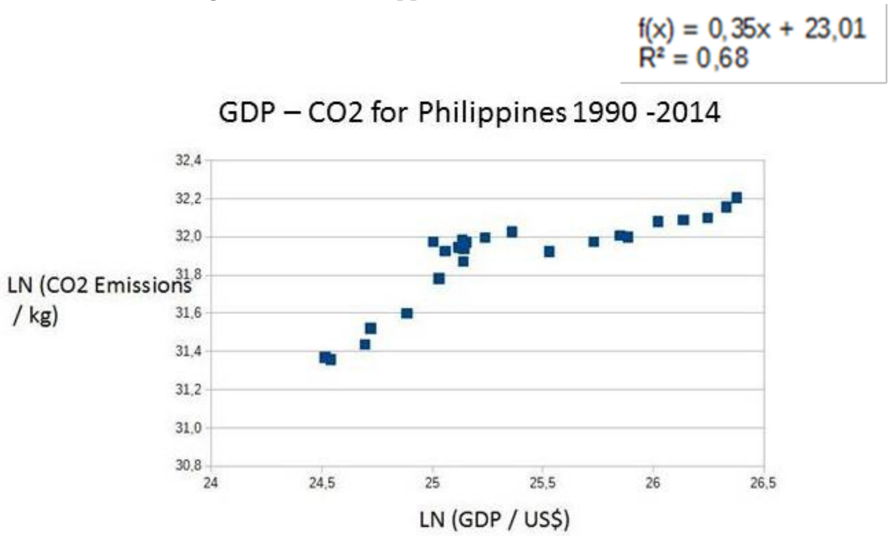

How Vietnam is to change in order to promote the COP21 goals, Goal I and Goal II) within a short period of some 10 years, given the ambition to maintain raid economic growth, is very difficult to understand.

Can really renewables do the trick? It is a highly relevant policy question, despite the massive employment of hydro power in this country.

The Philippines

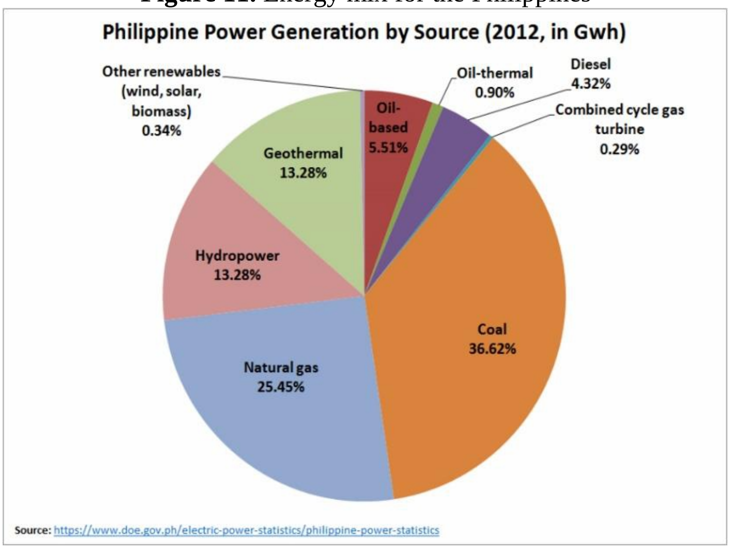
Giant nation the Philippines is very interesting, as they claim that they can handle the implementation of the COP21 goals. This may simply be rhetoric, which is just another form of reneging upon promises. Consider first the upward sloping trend in Figure 10.

**Figure 10**. The Philpppines: GDP-CO2:




The energy profile of the Philippines is actually more positive than several of the countries above, including a huge part of geo-thermal energy (Figure 11). Yet, fossil fuels dominate to a high 70 per cent, as in other populous and rapidly developing nations. The Philippines definitely needs help from the Super Fund.

**Figure 11.** Energy mix for the Philippines



The caching-up countries all have increasing slopes for the GDP-CO2 link, which entails profound difficulties to come for the accomplishment of Goal I in the CO21 project. In relation to the achievement of Goal II, one can say only note that tremendous investments have to be made by these countries in renewable energy and atomic plants, which they will find difficult to do.

For the poor nations in Asia with huge population holds that they cannot by themselves accomplish the objectives of COP21: Goal I: reverse current CO2 trend, Goal II: reduce by 40 per cent the CO2:s by 2030 and Goal III: full decarbonisation by 2075. As a matter of fact, they will need massive financial assistance from the Super Fund, which has still not been set up.

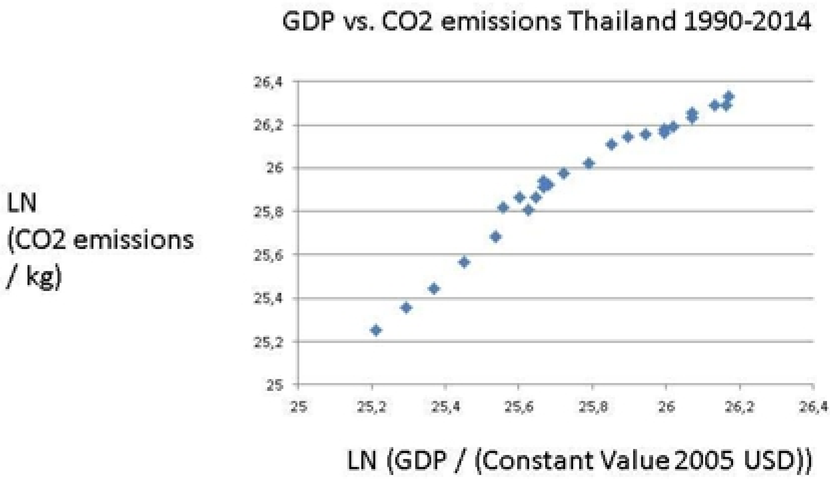
**B. Medium Affluent Third World Nations**

A medium income country with a not too large population can innovate, thus promoting decarbonisation by itself. But it may accomplish a more radical change with support from the Super fund, which entails extensive bargaining between the country and international governance bodies. Is a Pareto optimal outcome achievable, making Goal I and Goal II realities as outcomes?

Thailand

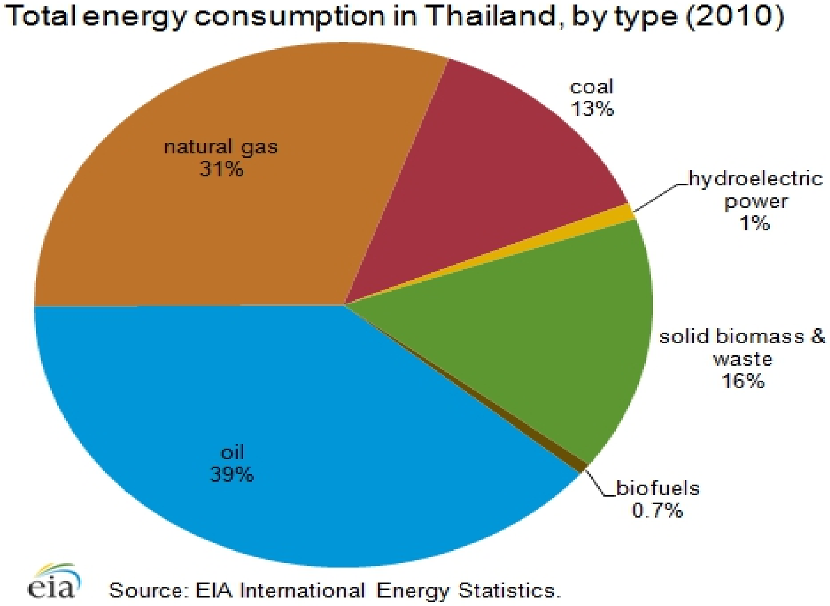
Figure 12 begins with Thailand that has become a rapidly developing country with increasing affluence and is besides furnishing large scale tourism a major car producer inter alia.

**Figure 12.** Thailand ($y = 1{,}07x$, $R^2 = 0{,}96$)




The CO2 emissions in Thailand are quite high, reflecting the economic advances in South East Asia. The trend is up and up. Can it be reversed without serious economic impact? Figure 13 shows the energy mix of this dynamic country, economically.

**Figure 13.** Thailand's energy mix

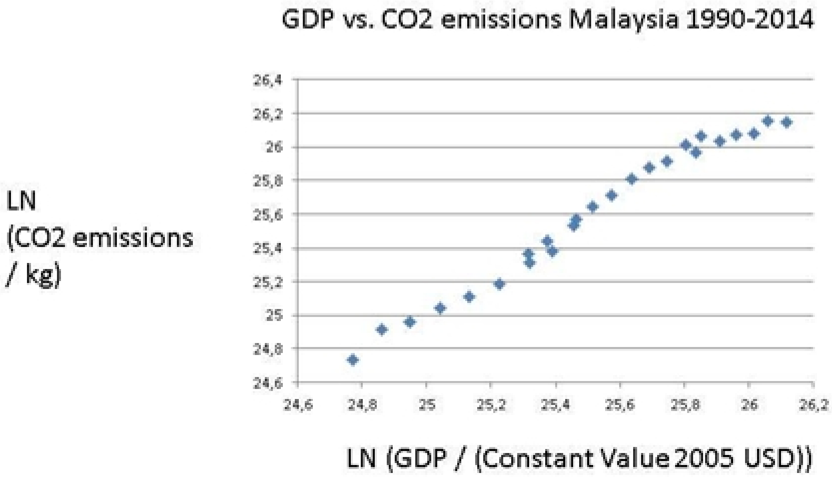



The reliance upon fossil fuels is high, or over 80% of energy consumption coming from the burning of coal, oil and natural gas. Hydro power is marginal, but bio-energy plays a major role, but it is really not carbon neutral. Thailand needs to come up with far-reaching reforms of its energy sector in order to comply with COP21 objectives.

Malaysia

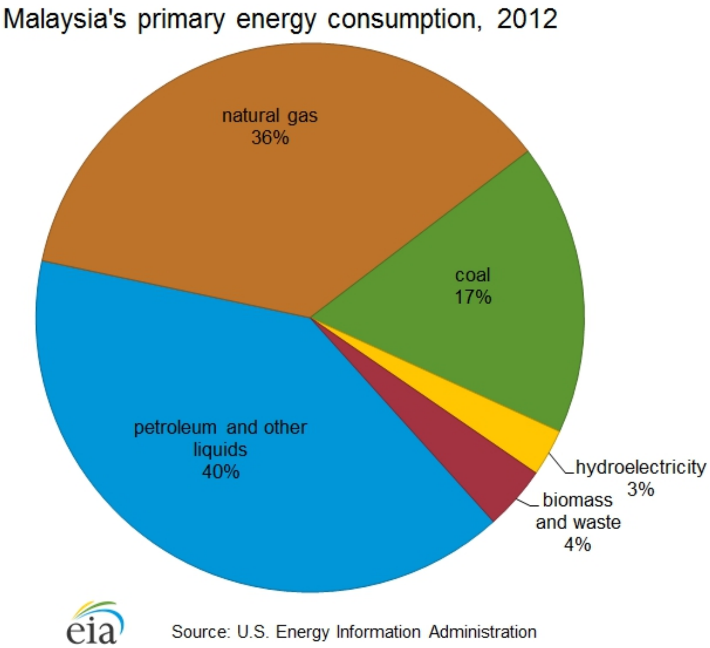
The overall situation – fossil fuels dependency – is the same for Malaysia as for Thailand. And the CO2:s are high, following the GDP trend (Figure 14).

**Figure 14.** Malaysia (y = 1,13x; $R^2$ = 0,98)



Yet, Malaysia employs energy of a very mixed bag (Figure 15), but still its emissions augment in line with economic development. There may be a planning out of the growth trend in emissions recently, but Malaysia use very little of carbon neutral energy sources. There is hydro power, but the country must move to solar and wind power rapidly.

**Figure 15.** Malaysia's energy mix




Renewables are not a major element in the energy consumption mix of Malaysia, as fossil fuels dominate, but not coal luckily.
Basic energy transformation in Thailand and Malaysia requires that the COP21 or CO22 sets up a *management structure* to assist these countries involving project evaluation, policy execution and implementation, control of financial flows and outcome assessment – a gigantic task with many pitfalls involved.

## V. Management Issues In Decarbonisation

One may separate between at least four types of management theories, looking at developments since the beginnings of the 20th century with the giants Weber, Fayol and Taylor. Lots have been written about the development of the managerial approach, but here we simplify matters a little to get to the point that is relevant for the COP21. Thus, we have:

1) *Instrumental rationality, or efficiency:* The basic paradigm is the means-end, to be employed for recommendations about improvement and change. How to organise things so that we have Max Outputs – Inputs – physical effectiveness? Or how to Max Revenues – Costs, when activities

can be measured in money ? This approach is normative, but not morally normative.

2) *Ethical rationality*: How to design the best organisations in an overall meaning? Management has to take various aspects of organisation into account, and not merely efficiency or productivity in a narrow sense. Thus, a list of evaluation criteria was developed and analysed : human relation dimensions like satisfaction, happiness, proudness etc., environmentalism, service to local communities, lack or corruptibility, etc. The overall assessment favour management in organisations constrained by market forces. Thus, socialist management was outlawed and cronyism criticised.

3) *Real life management, or bounded rationality*: Even if managers would try hard, which they do not always happen to do, they face cognitive limitations, barring comprehensive rationality of type 1). Instead they must concentrate upon a limit set of established objectives and rely upon a safe set of means, or technologies. H. Simon labelled this management style « standard operating procedures ».

4) *The garbage can model of foolish management*: March, once a collaborator of Simon, took the limitation on rational decision-making to its ultimate conceptual opposite with Norwegian Olsen, viz organised foolishness. If it were to be true of COP implementation, then we should not try this. We will wait and see what happens and how to react in a peace-meal fashion, i.e. the policy of resilience with Wildavsky. However elegant theoretically, the garbage can model always suffered from an ambiguity:

- is garbage can modelling *necessarily* true of management, public, private, international, etc.?
- or is this model merely a *contingency,* covering a few cases of policy failures and management errors ?

I believe the second tenet is defendable, but certainly not the first tenet.

Approaching COP implementation, one would still bet upon the management approach 1), searching for policies that eliminate fossil fuels for electricity production and bring down CO2 emissions in transportation. It can be done, but will it be enough for the COP21 objectives.

The achievement of decarbonisation according to the COP21 goals (I-III) is going to stumble upon the implications of the Kaya model, namely that CO2 emissions are fundamentally driven by economic forces, like the GD per capita and the size of the population besides energy and carbon intensity. To make it feasible for large poor countries to reduce CO2 emissions but yet maintain a decent level of economic development, the

Super Fund must be made operative. Yet, it does not even “exist” in a more articulate form on paper. Countries in South Asia could not bear the costs in large scale energy transformation alone, let alone also fund policies against poverty. Several countries may accomplish superior outcomes, if funding I shared with the Super Fund.

It seems that the already existing *Green Climate Fund* may be transformed into the Super Fund with a budget of 100 billion a year, but it would have to be completely restructured. The management tasks involved are enormous, not to talk about the financing. The Third World will keep reminding the First World about this promise, which constitutes a *sine qua non*.

Could the financing come from a Tobin tax or perhaps a global carbon tax? If so, global stock markets will become involved, this has not happened yet. Many First World countries are direly indebted, like the EU and the US. If financing is very uncertain, then the implementation of projects faces enormous hurdles in the form of cost efficiency, risk of corruption and embezzlement as well as conflicts between national, regional or local governments and international bodies. The implementation of the COP21 goals requires a firm state with capacity to deliver on policies, but many Third World countries have weak or fragmented states.

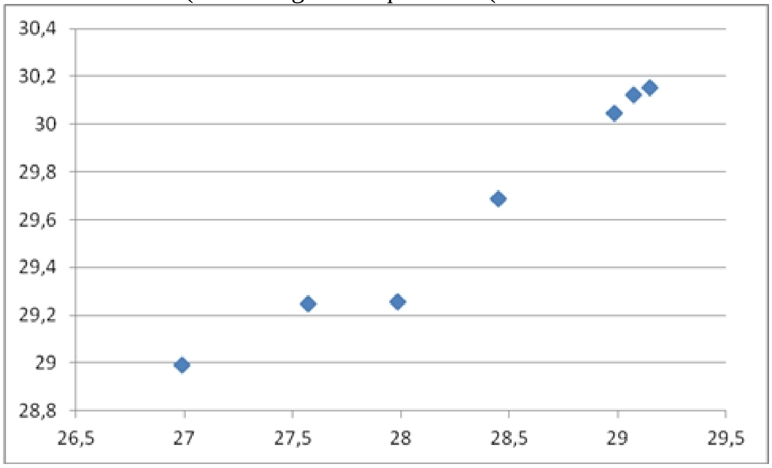
A few nations can probably not rely upon any foreign assistance or th Super Fund, because they are highly developed technologically and can draw upon own substantial financial resources.

## VI. First World Nations

One may find that the emissions of GHG:s follows economic development closely in most countries. The basic explanation is population growth and GDP growth – more people and higher life style demands. However, some mature economies display downward sloping GDP-CO2 curve: the US, several EU countries and Japan. Now, look at the case of China, whose emissions are the largest in the world, totally speaking (Figure 16). China was a Third World country up until yesterday.

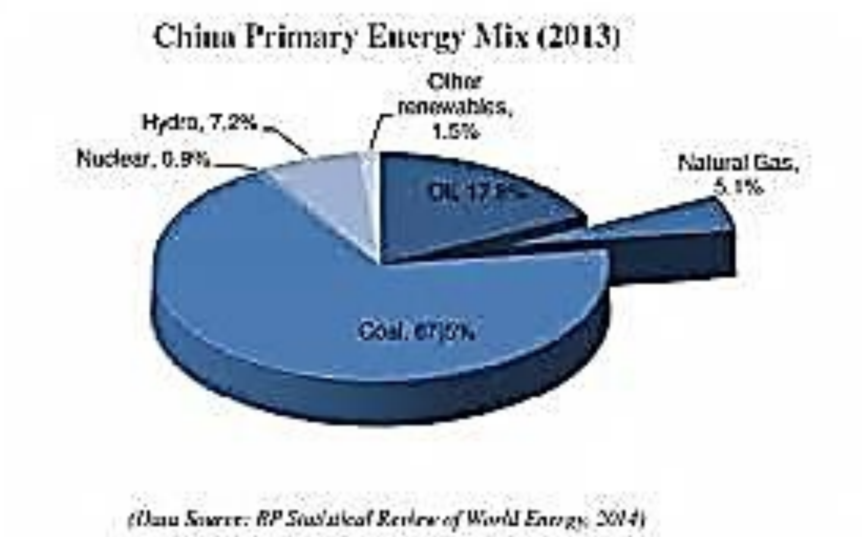
China

**Figure 16.** CHINA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)




The sharp increase in GHG:s in China reflects not only the immensely rapid industrialization and urbanization of the last 30 years, but also its problematic energy mix (Figure 17).

**Figure 17.**



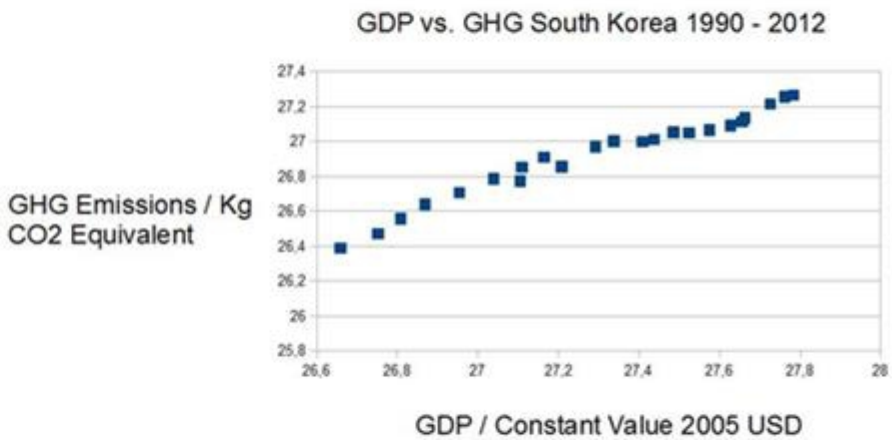

Almost 70 per cent of the energy consumption comes from the burning of coal with an additional 20 per cent from other fossil fuels. The role of nuclear, hydro and other renewable energy sources is small indeed, despite new investments. This makes China very vulnerable to demands for cutting GHG emissions: other energy sources or massive installation of highly improved filters?

It should be pointed out that several small countries have much higher emissions per capita than China. This raises the enormously difficult problematic of *fair cuts* of emissions. Should the largest polluters per capita cut most or the biggest aggregate polluters? At COP21 this issue was resolved by the creation of a Super Fund to assist energy transition and environment protection in developing counties, as proposed by economist Stern (2007). But China can hardly ask for this form of foreign assistance. It is true that China energy consumption is changing with much more of renewables ad atomic plants. But so is also demand increasing with new and bigger cars all the time plus increased air traffic on huge new airports. Can China really cut CO2:s with 40 per cent while supply almost 50 per cent more energy power, according to plan?

South Korea

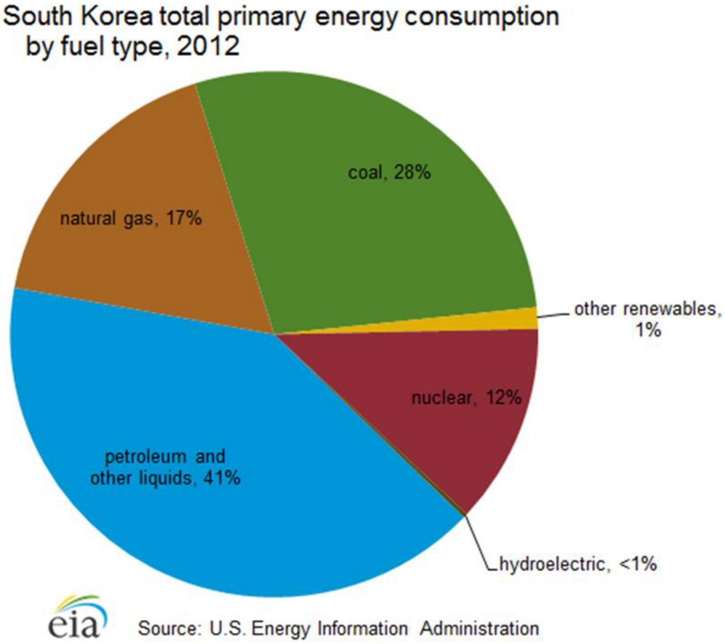
Industrial giant South Korea is very interesting from the perspective of the COP21 Agreement, because the basic trend violates both Goal I and Goal II. An entirely different trend than that of other mature economies is to be found in South Korea (Figure 18), which has 'caught up' in a stunning speed but with enormous GHG emissions.

**Figure 18.** SOUTH KOREA: LN (GHG / Kg CO2 eq and LN (GDP / Constant Value 2005 USD)




Lacking much hydro power, South Korea has turned to fossil fuels for energy purposes, almost up to 90 per cent (Figure 19). Now, it builds nuclear plants, but South Korea needs to move aggressively into solar power to reverse trends.

**Figure 19.** Energy in South Korea




It differs from China only in the reliance upon nuclear power, where the country is a world leader in plant constructions. Reducing its GHG emissions, South Korea will have to rely much more upon renewable energy sources, as well as reducing coal and oil for imported gas or LNGs.

Neither China nor South Korea are on line for fulfilling the COP21 Goal I, as they are not reducing their emissions, like other advanced or mature economies as Japan, the EU and some EU nations. Goal II seems far away in terms of achievement for these two industrial giant, still very dependent upon fossil fuels. They innovate with renewables, but hope to consume even more energy in the coming decade.

## Conclusion

The GDP-CO2 link is upward sloping and the energy consumption mix is dominated by fossil fuels and sometimes wood coal in most countries. A most radical transformation towards renewables and atomic power is a *sine qua non*. Thus, the global warming process is fundamentally unstoppable due to coordination failures – i.e. social sciences paradoxes. Climate change will write its message in red, resulting in climate refugees, loss of coastal areas and the destruction of healthy oceans. People will dies in large numbers, either from starvation or flooding or thirst. Economic depression will follow as demand falters. War between nations becomes unavoidable. Today state coordination is too weak and the costs involved in the implementation of the COP21 goals (I-III) too huge.

***GDP sources:***
World Bank national accounts data - data.worldbank.org
OECD National Accounts data files

***GHG and energy sources:***
World Resources Institute CAIT Climate Data Explorer - cait.wri.org
EU Joint Research Centre Emission Database for Global Atmospheric Research - http://edgar.jrc.ec.europa.eu/overview.php
UN Framework Convention on Climate Change - http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3814.php
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