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ASIAN GREENHOUSE GASES: THE CHAOS RISKS

[1]Jan-Erik Lane and [2]Florent Dieterlen

[1]Fellow with Public Policy Institute, BELGRADE; Address: 10 Charles Humbert, 1205 Geneva; 559 A, 3rd Floor, Thuya Street, 9th Quarter, Yangon. Myanmar.

[2]Independent scholar, Geneva.

ABSTRACT

To answer the key question by N. Stern: "What are we waiting for"?, one must place global warming and the policy debates about climate change in the UN agendas, UNFCCC and IPCC, in a political economy perspective. Conka (2015) and Vogler (2016) have shown that the great powers on the Planet – the G20 group nations – are hesitant to do something real about the causes of climate change, preferring to move the issues from one agenda to another in order to delay action. Most countries are very committed to further economic growth, which requires much new energy leading to more greenhouse gases

Keywords: de-carbonisation, future energy demand, Asian economic dominance, climate change risks

INTRODUCTION

Climate change belongs to the external effects. These phenomena have been well analysed in economic theory and public policy. The general solution is to put a price upon the allocation of externalities so that their costs are born by the parties causing them, but this can be done in several ways – taxes, permits, legislation, etc. External effects are particularly difficult to handle when there is open access, like e.g. the global atmosphere. Climate change concerns all countries in the international system of states, where emissions of e.g. CO2s or methane go around the planet from any place.

One method for controlling externalities is the formation of a club with all parties concerned, harbouring a regime that regulates the production of external effects and distributes somehow the costs to the producers. When it is a matter of open access resources, one speaks of a common pool regime, the CPR. The COP21 is an example of a CPR, but it is yet to be implemented.

Climate change is a global phenomenon, so this CPR is an Ocean coordination mechanism, covering almost all states in the world. They meet in yearly talks, which are transaction heavy with few concrete results, except promises. Given the nature of the international system and its reliance upon state sovereignty, the COP reunions can only discuss and recommend. Here we have the first error in anti-global warming policy-making.

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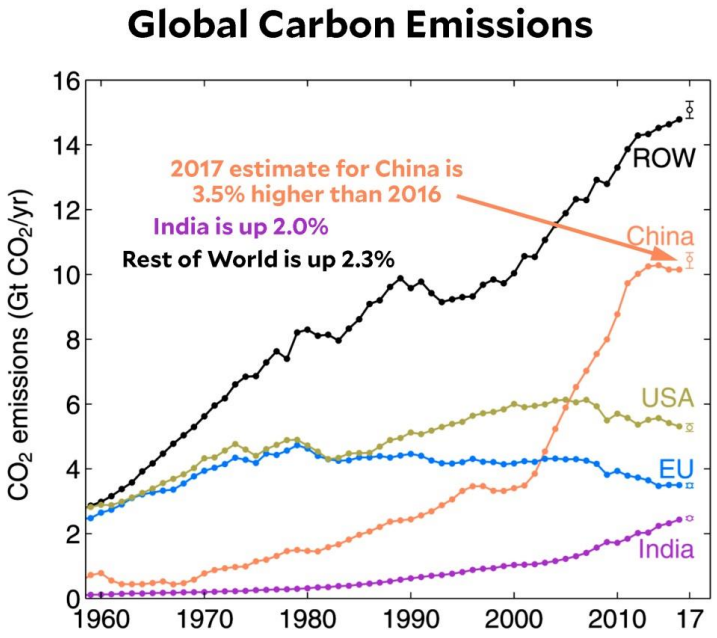
Over 70 per cent of the GHGs are produced by the G20 group of nations that could take decisive action without drowning in transaction costs. They meet regularly and their actions against climate change would have decisive impact. Figure 1 shows the major emitters of CO2s.

FIGURE 1. CO2emissions up to 2017



Source: https://www.motherjones.com/kevin-drum/2017/11/carbon-emissions-set-to-rise-in-2017-after-two-years-of-plateau/

We see from Figure 1 that the CO2s are increasing again globally, after a short period of stagnation. Most of the emissions come from the many EU countries, US, China, India, Japan, Australia and Canada.

Applying the basic principle of polluter pays, the G20 set of nations should take action to reduce not only CO2s but also the other GHGs, like for instance methane.

PROMISES AND RENEGING

The COP21 Treaty is just a paper outlining global de-carbonisation:

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i) The COP21 Treaty of 2017 in Paris enters into the global system of international relations. Thus, an answer to Stern's question must be found in the inertia of global political coordination, which harbours lots of gaming, promises and defection. From the point of view of state rationality, one government may delay anti-global warming policy-making and policy implementation if it trusts that other governments will act, or believes that no government will act. If all governments do the same, there is complete coordination failure. Stall the rise of CO2s by 2020 (GOAL I);
ii) Decreasing the CO2s by 30-40% by 2030 from some level base line in the past (2005) (GOAL II);
iii) More or less full de-carbonisation by around 2075 (GOAL III);
iv) Decentralised implementation under international oversight, financial support and technical assistance.

These are enormous goals, as only one country – Uruguay – is near GOAL I and GOAL II. Can they be implemented? Or will the states to the Agreement renege in a giant *ocean PD game* (Prisoner's dilemma)? Few countries have decreasing CO2 curves today.

Under international law, the states signing and ratifying COP21 are bound by their promises, but the COP21 is all but clear:

a) No sanction against non-compliance is outlined;
b) A control mechanism of the fulfilment of promises is only sketched minimally;
c) Big money is promised from a so-called Super Fund, to assist countries in energy transformation, but no funding or management strategies are outlined.

The difficulty is defection. First, the respect for international law depends much upon the states' wish to comply, as sanctions from the Security Council are restricted to issues of war and peace. Second, all CPRs face the temptation of reneging. When a country notices that it promised too much, like the COP21 project, it simply reneges, allowing for increases in GHGs.

As anti-global warming policy-making has been entrusted the UNFCCC framework, the climate change problematic has been confounded with other issues, like global redistribution, sustainable economy, poverty alleviation, etc. This is the second error in today's anti-global warming project.

It would be preferable if a smaller body like the G20 group of nations could concentrate upon ONE issue – climate change – and take effective measures that save mankind from the point of Hawking irreversibility, i.e. when global warming becomes unstoppable and so severe at 4-6 degrees plus Celsius that humanity is threatened.

STYLISED ENERGY PLANS

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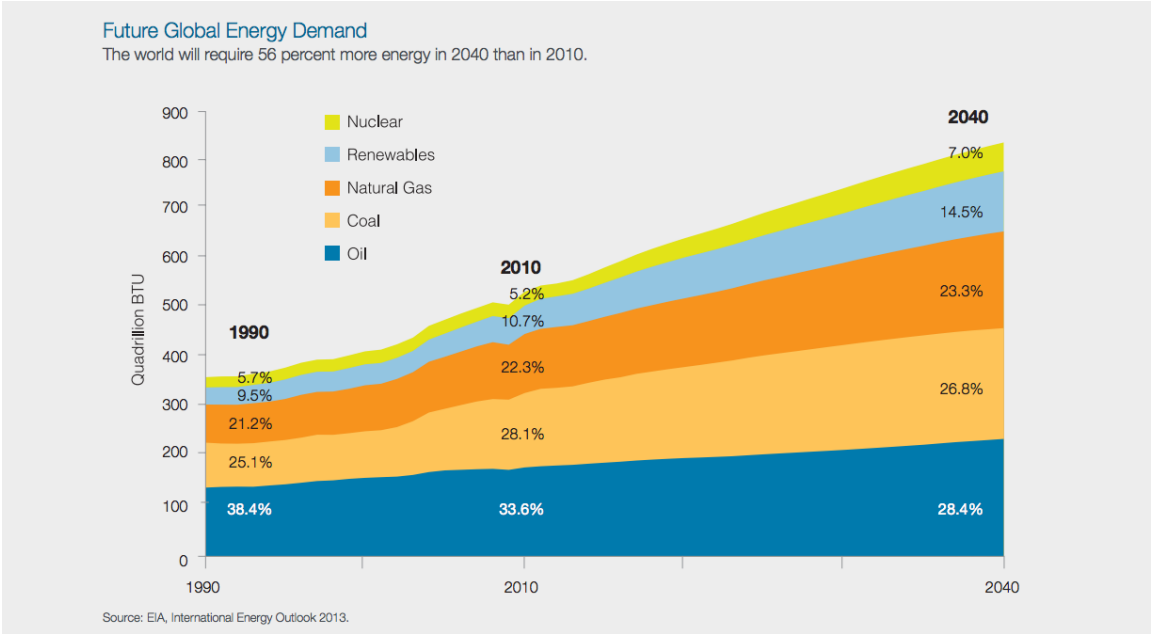
The COP21 Treaty is just a set of promises that can be reneged upon at any time. The US has already defected and aims at becoming the global exporter No 1 of oil and gas in the near future by means of the new technology of fracking, which is detrimental to the environment. China promised to stem its CO2 increases already 2016, but it now increases again. Germany and Australia appear to talk about some form of defection. And India would certainly renege without billions from the Super Fund. And South Korea has given up parts of its nuclear power program and bets on the LNG option instead, which Japan may also chose, although carbonization writ large.

To estimate the likelihood of the implementation of global de-carbonisation according to the COP21 Agreement, one needs to look at the standard energy projections among the global players. Energy is at the core of the climate change debate. And energy consumption is enormous at the same time as energy demand is projected to further increase substantially.

The Internal Energy Outlook 2013 by the EIA presented the following scenario, which hardly amounts to de-carbonisation.

FIGURE 2. EIA, projection 2013



The same observation is to be made in the standard BP projections.

FIGURE 3. BP, projection 2015

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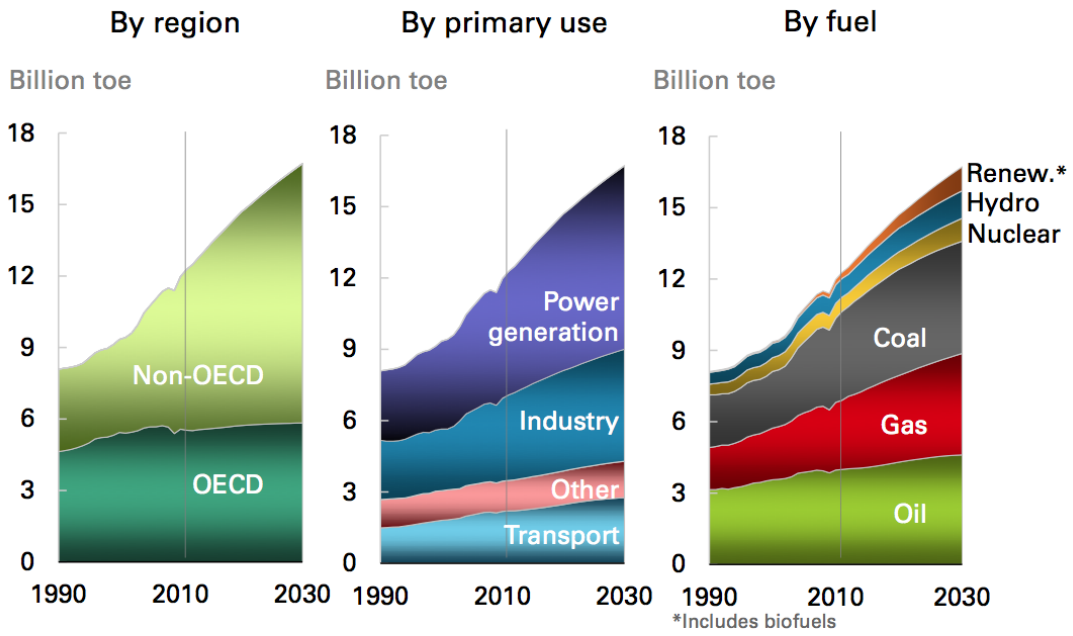
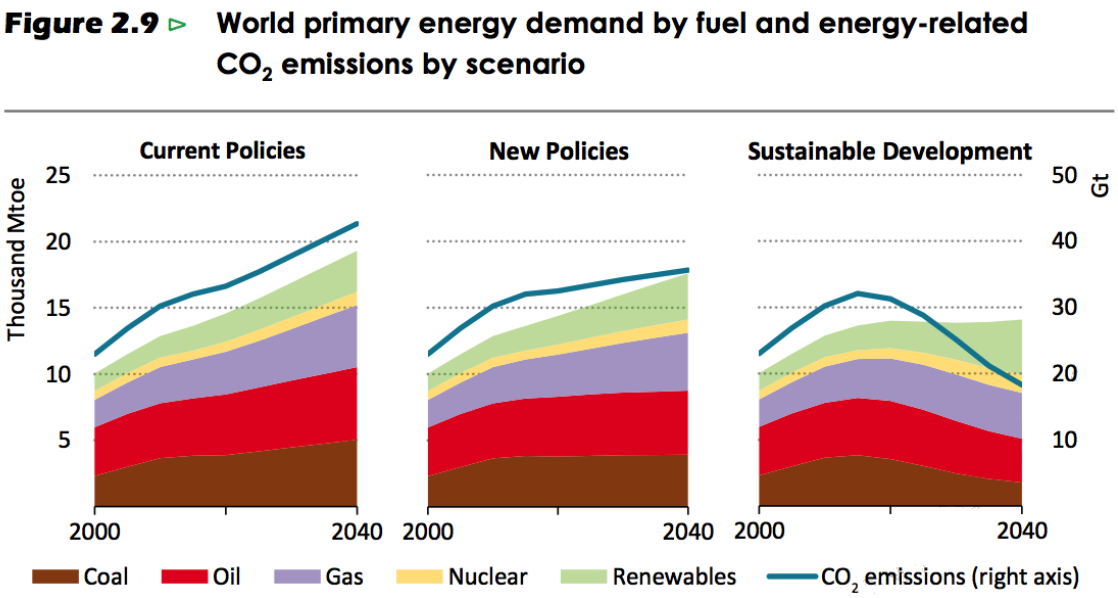


Finally, the International Energy Agency does not deviate in its normal case. "Sustainable development" scenario is utopian.

FIGURE 4. IEA, projections 2017



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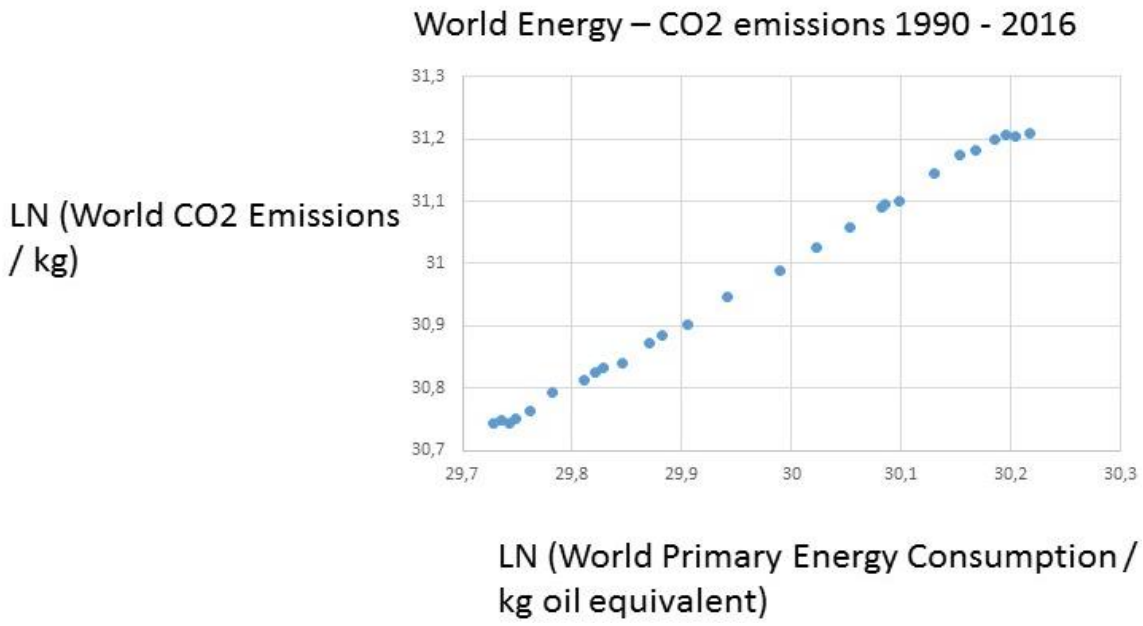
THE GHGs have two sources, nature and humans. It is the anthropogenic sources that now are the major causes of global warming. Why? Because humans need energy in ever greater supply. Without energy, no affluence.

ENERGY AND EMISSIONS

Energy demand in the coming decades will be enormous in Asia, as poor people try to change their situation and the new middle classes strive for even more of affluence as well as the newly rich billionaires and millionaires throw themselves into conspicuous consumption. Can Asia manage de-carbonisation and at the same time augment energy supply with 30-50 per cent? Figure 5 shows the global connection between energy consumption and CO2 emissions.

FIGURE 5. Energy and CO2:s:y = 1,01x; R^2 = 0,99



Source: BP Statistical Review of World Energy 2017, http://www.bp.com/statisticalreview;Janssens-Maenhout, et al, 2017.

There is a one-to-one relationship over time between energy consumption and CO2 emissions. The Asian continent is the largest GHG emitter of all continents on Planet Earth. The cost is clear, as the Asian Development Bank states (ADB, 2015: Foreword).The ADB calls for anti-global warming policies, recommending carbon capture and sequestration. This technique would allow for continued high economic growth, but it is neither safe nor least expensive, as solar power parks offer a better technique, given much sun on this continent. Figure 6 displays the

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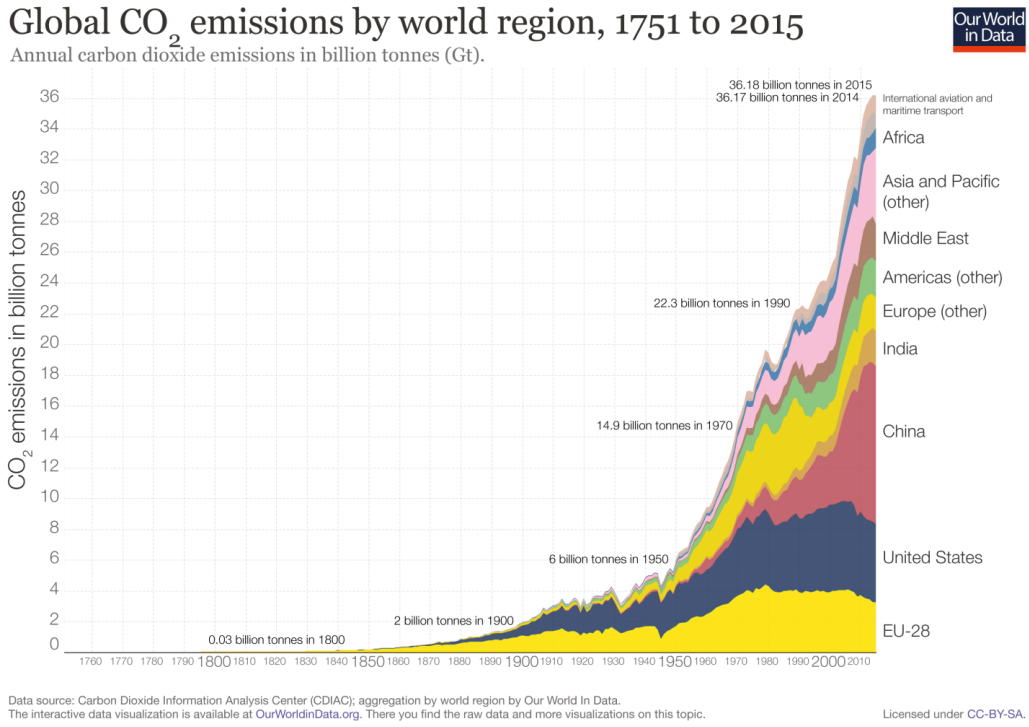
huge augmentation in CO2s in Asia. Note also the big contribution by maritime and airborne transportation.

FIGURE 6. CO2 EMISSIONS by Region



The greenhouse gases (GHG) have anthropogenic sources, being linked with socio-economic development or economic growth via the consumption of energy, especially the burning of fossil fuels, use of cement and the emission of methane from land sinks, cows, microbes, etc. The UNFCCC has focused on halting CO2s and decreasing them in a gigantic de-carbonisation policy globally in this century.

Since 1970, global energy consumption has more than tripped. And the share of Asia has increased phenomenally. The Asian economic miracle started in Japan after the Second War, spread to the four miracles – Taiwan, South Korea, Hong Kong and Singapore – only to include mainland China since 1980, in order to further widening to South East Asia and South Asia plus Kazakhstan as well as the Middle East oil and gas tycoons (Figure 2). Now Asia has more than 50% of all energy consumption and it is more than 80 percent fossil fuels, globally. In several Asian countries, fossil fuels make up 90 percent of energy consumption.

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This economic revolution has made Asia harbor the set of factories of the world, thus increasing quickly affluence and wealth as well as succeeding in diminishing poverty. But energy transformation requires huge changes in Asia, like the elimination of coal as soon as possible

METHANE THREAT

There are several greenhouse gases, but the two biggest are the CO2s and methane. The UNFCCC has concentrated upon halting and reducing carbon dioxide, but now we are about to face a methane threat. We shall use the methane concentration curve from mid-2013 to beginning of 2017 by NOAA ESRL (https://www.esrl.noaa.gov/gmd/ccgg/trends_ch4/), as suggested by Dlugokencky and Kuniyuki. Why mid 2013? It is the last maximum of the second derivative before 2017. Since then, the curve is approximately linear, and we will derive its equation hereunder.
We start with a linear approximation, the simplest approximation that can be found, because it is a mean between two extreme scenarios: 1) Another plateau like during the years 1999-2006 (probably due to an enhancement in methane transport insulation in ex-USSR after 1991, unlikely for the following reasons. 2) Any decrease in methane concentration is very unlikely; as the main sources (in decreasing importance order) generally increase:

- Agriculture emissions increase with the increase of population, the increase in meat diet in developing countries and the temperature increasing the metabolism of microbes in rice agriculture.
- Wetlands emissions do not diminish, as the microbial chemical activity will increase with temperature for many years.
- Fossil fuel production and use does not diminish, and was underestimated by industry, fracking (Fred Pearce, http://e360.yale.edu/features/methane_riddle_what_is_causing_the_rise_in_emissions).
- Biomass burning does not diminish, as the primary forest diminishes in the tropics, leading also to a decrease in animal, vegetal and cultural (Indigenous People) diversities and an increase in biosphere entropy.
- Other natural emissions, like from the melting permafrost.

The most important contribution to the recent rise of methane concentration is mainly due to the increase in activity by microbes, present mainly in the tropics. This study suggests the positive feedback of the chemical increase of activity of microbes is starting now, yielding a quasi-exponential curve in the near future, or at least a steeper curve.

We will simulate the hypothetical solution of a transition (bifurcation) between 2 steady-states; with an S-shaped function (which approximates the bifurcation between 2 steady-states) multiplied (to have continuity) by the linear approximation. We shall approximate the S-shape curve by a transitory (5 years) exponential curve in continuity with the linear approximation (Diagram 1)).

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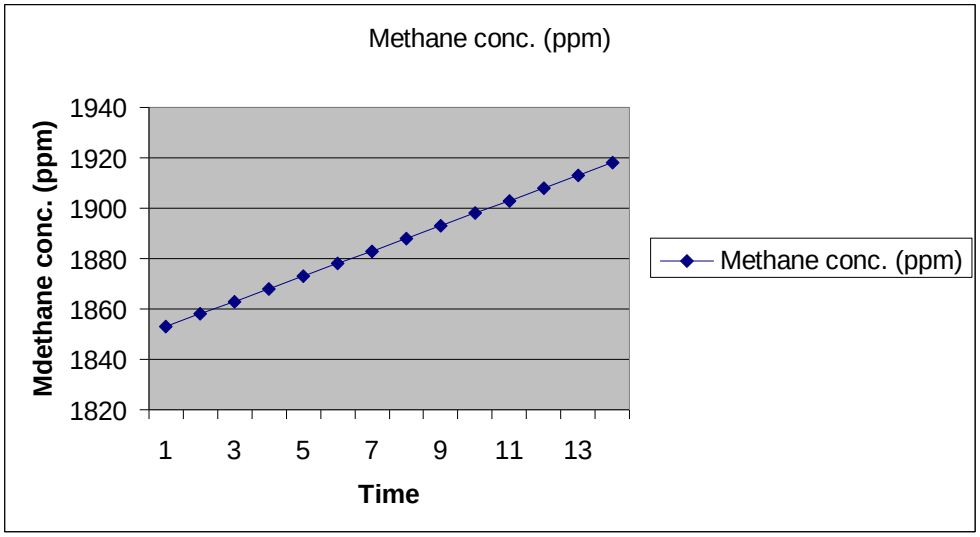
DIAGRAM 1.Projected increase in methane (Dieterlen)



CO2 EMISSIONS IN ASIAN: Some examples

China: 20% more energy up to 2030

China has expressed support for COP21, especially when smog hits Beijing. But its economic expansion endeavours remain unchanged, not least over Asia with the New Silk Road. Alarming information now arrives that China, the biggest emitter of CO2s, will not succeed to halt its curve for CO2s due to hydro power shortages. Instead, it counts upon some 3 per cent increases the nearest 1-2 years – see Figure 7.

FIGURE 7. China: GDP and CO2s: $y = 0,46x$, $R^2 = 0,98$

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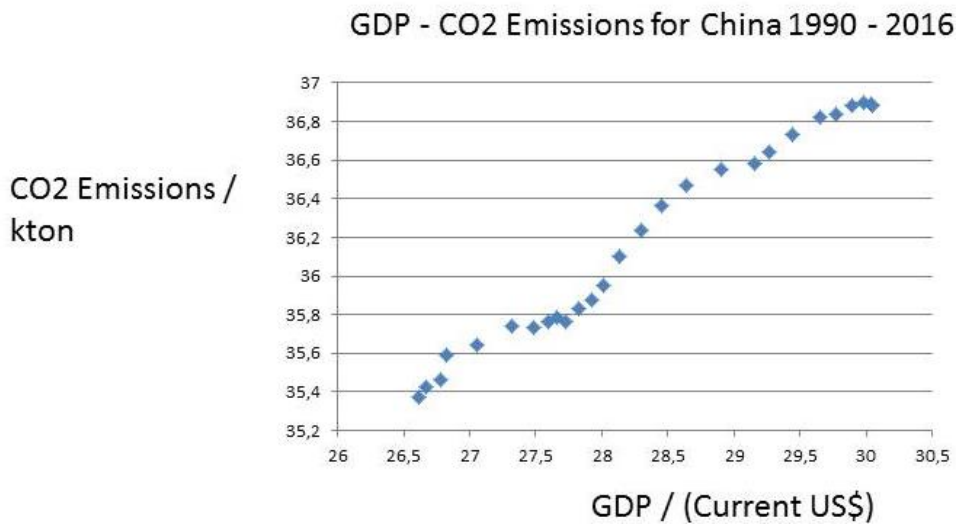

Will China renege upon both GOALI, halting the increase in CO2s, and GOAL II, reducing CO2s by some 30 per cent in 10 years? Promises and intensions are one thing, defect, but real life developments are another matter. All countries in this CPR can at any time renege, the US has already done being not willing to pay to the Super Fund.

China invests in both nuclear power and modern renewables. Yet, it has magnificent economic ambitions over the next decades:

i) Airports and own constructed aircraft;
ii) Largest air traffic in the world;
iii) Biggest car market in the world'
iv) More SUVs and ever larger engines;
v) The New Silk Road: infra structure expansion into Central Asia, Pakistan and the Middle East.

Air and sea transportation adds much to CO2 emissions. Even if electrical cars are launched massively in China, one must ask where the electricity comes from. Coal?

China expanding outward meets first Kazakhstan when building the new highway to Turkey, an enormous project with CO2 consequences.

FIGURE 8. China's future energy mix

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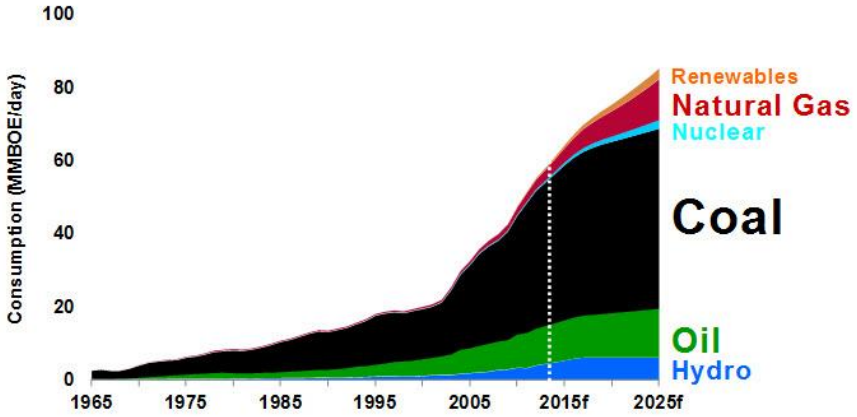
Figure 1: China Energy Consumption by Type
1965 to 2025f



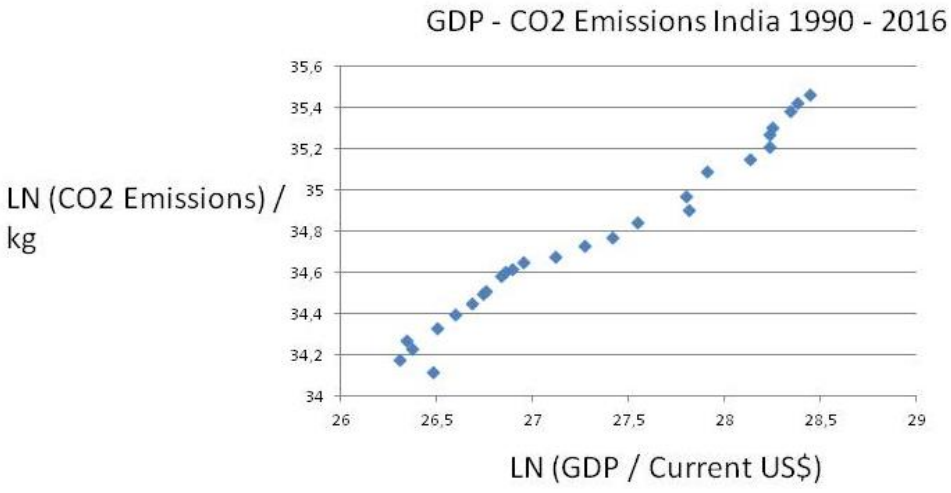
Source: Historicals - BP, Forecast - ARC Financial Research

Figure 8 send a vision of a future that is not the same as that of the COP21 project.

India: Super Fund Hope

Its Rostov take-off point in time would 1990, when Nehru's economic regime was abandoned for free market economics. Unleashing the dormant giant of India has led to enormous economic expansion and growth in Co2s – see Figure 8.

FIGURE 8. INDIA: GDP and CO2



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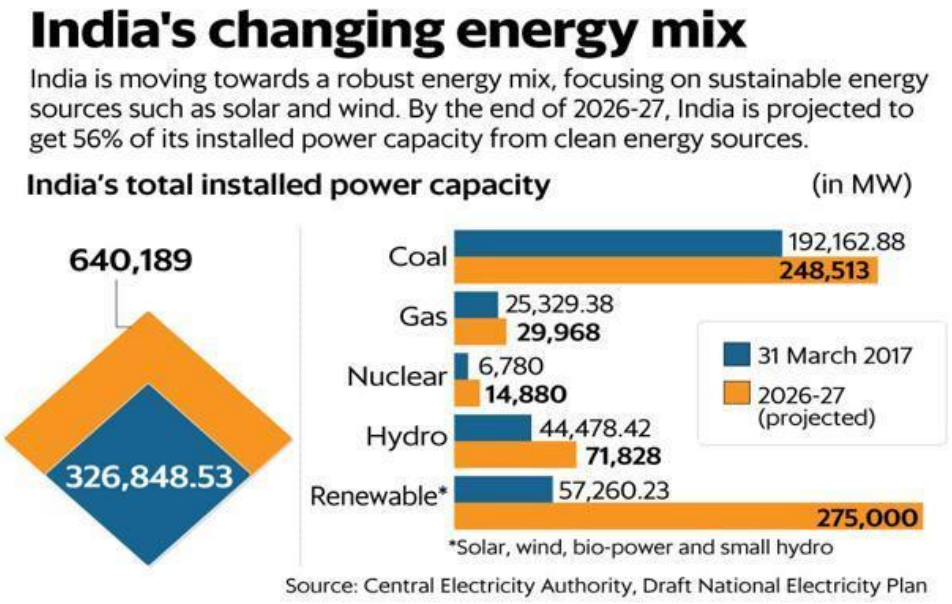
India takes the position that any reduction its economic growth due to the fulfillment of global decarbonisation must be compensated by the West. Moreover, the Super Fund should be employed for the energy transformation that is necessary for India to comply with GOAL I and GOAL 2.

Ramesh (2015) insists that India cannot alone uplift its million poor without coal power. In addition, families in India rely much upon wood and charcoal – traditional renewables. The country is investing in nuclear power and modern renewables. However, its hydro power suffers from water scarcity – a positive feedback loop from climate change.

FIGURE 9. India's planned energy mix (Excluding transport)



India says that it will renege, if no massive support from the Super Fund. Its future plans, according to Figure 9, comprise a 20% energy increase. And it must reduce coal more to comply with COP21. Renewables in India consist of much wood coal.

Indonesia: Massive emissions

One may guess correctly that countries that try hard to "*catch-up*" will have increasing emissions. This was true of China and India. Let us look at three more examples, like e.g. giant Indonesia – now the fourth largest emitter of CO2:s in the world (Figure 10).

FIGURE 10. Indonesia's link GDP-CO2: $y = 0,95x + 1,6$; $R^2 = 0,89$

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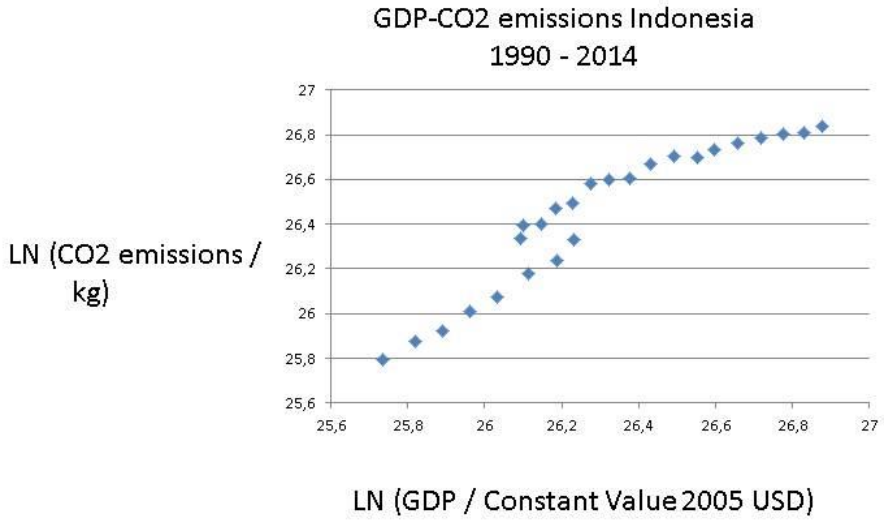

Indonesia is a coming giant, both economically and sadly in terms of pollution. Figure 10 reminds of the upward trend for China and India. However, matters are even worse for Indonesia, as the burning of the rain forest on Kalimantan and Sumatra augments the GHG emissions very much. Figure 11 presents the energy plan for this huge country in terms of population and territory.

FIGURE 11. Indonesia: future energy mix

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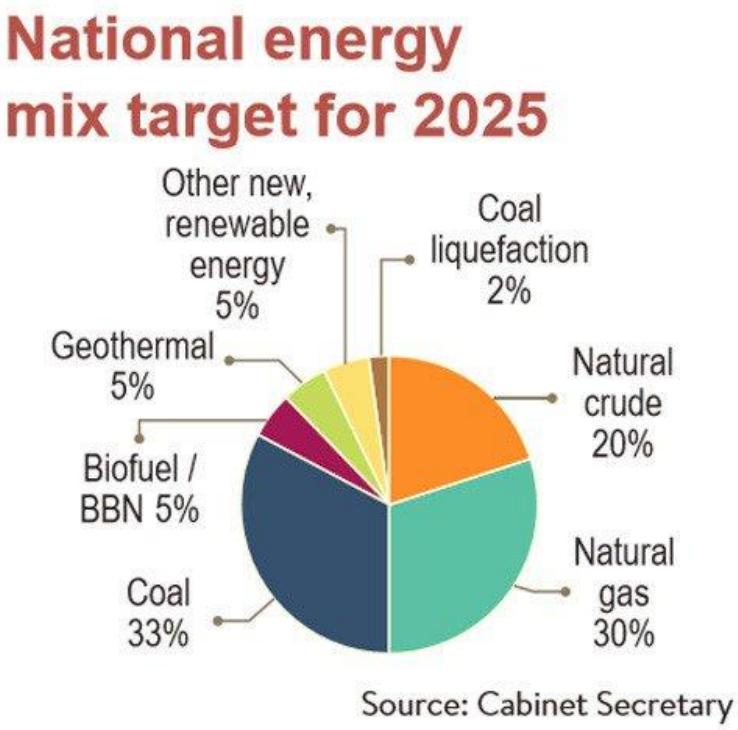

Source: http://www.thejakartapost.com/news/2016/12/06/pln-to-buy-waste-based-power-from-7-cities.html

Not much decarbonisation planned, according to Figure 11.Indonesia cannot control the illegal burning and cutting down of its rain forest. Thus, it is a very major contributor to global warming.

MANAGEMENT

The UNFCCC suggests a decentralized management strategy for decarbonisation. Reflecting the enormous differences in available energy resources in the member states of COP21 Treaty, each government must develop a strategy for achieving Goal I, Goal II and Goal III. The COP 24 in Poland 2018 may wish to concentrate upon the following measures start credible decarbonisation:

1) Phasing out coal power plants; convincing a few countries like India and Australia not to build new ones;
2) Replace wood coal with natural gas – small or large scale, stopping deforestation and the use of charcoal in households in poor nations, giving them free small gas ovens;

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3) Turn some countries away from massive dam constructions towards solar power parks, like Brazil and India, as the environmental damages are too big;
4) Help some countries maintain their huge forests: Brazil, Indonesia, Malaysia, Russia, Congo, India, Thailand, etc;
5) Abstain from expensive and unsafe carbon sequestration techniques in favour of electricity: solar power and electrical vehicles.
6) The promise of financial support – Super Fund –has to be clarified about both funding and budgeting. A management structure has to be introduced for oversight of the entire decarbonisation process. As the emission of methane increases, the reduction of CO2s is all the more important, if irreversibility is to be avoided with a margin.
7) The resort to atomic power plants is highly contested. Nuclear power gets safer and safer, but the problem of storing the used uranium has no solution yet, although Finland says it knows how. Old atomic plants could be made much safer in France and Germany for instance. Full scale climate change would be worse than single nuclear disasters.
8) Massive construction of solar power and wind power plants in all countries, as well as stimulate small scale solar power; Solar power parks: How many would be needed to replace the energy cut in fossil fuels and maintain the same energy amount, for a few selected countries with big CO2 emissions? Table 1 has the answer.

Table 1. Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: (Note: Average of 250 - 300 days of sunshine used for all entries except Australia, Indonesia, and Mexico, where 300 - 350 was used).

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
China	none[i]	0	3300
India	none[ii]	0	600
Japan	26	460	700
South Korea	37	260	280
Philippines	70	70	40
Turkey	21	60	120
Indonesia	29	120	170

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Saudi Arabia	none[ii]	0	150
Iran	4 – 12[iv]	22	220
Kazakhstan	none[ii]	0	100
Turkey	21	60	120
Thailand	20 - 25[iv]	50	110
Malaysia	none[ii]	0	80
Pakistan	none[ii]	0	60
Bangladesh	3,45	2	18
Australia	26 – 28	130	190
World	N/A	N/A	16000

Notes: i) The United States has pulled out of the deal; ii) No absolute target; iii) Pledge is above current level, no reduction; iv) Upper limit dependent on receiving financial support; v) EU joint pledge of 40 % compared to 1990.

The Asian economic miracle, spreading wider and wider, is going to run into mega pollution from GHGs. It would undo much of the immense advances the recent decades. Solar panel parks are the reply, and not carbon capture, suggested by the Asian Development Bank (ADB).

CLIMATE CHANGE AND CHAOS THEORY

The most recent news about the severe negative impacts of global warming is an article in *Science* saying 1/4ths of the oceans have become oxygen empty – de-oxygenation killing fishing and local people livelihood. Can the chaos approach help analysis these drastic changes and their consequences?

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Chaos was discovered in the 60s by E. Lorenz, who was studying equations ("differential equations") applied to climate. He found a system of three such equations, coupled with a positive feedback and a negative feedback, which could not be predicted in the future.

When trying to predict the evolution, two starting conditions very close one to each other will have two very different evolutions. Even if the 2 initial conditions are infinitesimally close! That's why the "butterfly effect" started to be cited: if a small (infinitesimally) variation of weather (the "wind" produced by a butterfly) would imply a big variation in the weather far from there. In fact, this is wrong, because the Lorenz equations are too simple for climate, and are simply wrong for climate.

So chaos equations are useless to predict, even if climate is chaotic. But there are other coupled differential equations, which can help predict things in climate. They are simpler mathematically than chaos, but they have also at least a positive feedback and a negative feedback.

How do they predict? They are unstable for certain conditions (for example for methane above a given concentration), and we can calculate this instability. Therefore, we can know when the system (climate) will jump from one state to another. Practically, it can be: Earth temperature jumps form 17 degrees in 5 years to 20 degrees in 6 years. The positive feedback is necessary for the system to jump, and the negative feedback is necessary for the system to be stable when it doesn't jump.

The climatic system (a few climatic variables, as temperature, CO2 and methane concentrations, and maybe one or 2 other variables) is modelled thanks to a method that transforms chronological data (e.g. monthly data) into those equations.

A stability analysis on a parameter (methane concentration, if we did not put methane as a variable but as a parameter), would see when the system gets unstable, if it does. Without methane, it didn't become unstable, but with methane, it likely becomes unstable.

One can show the system as arrows between the variables: each arrow showing if variable A increases or decreases, this affects variable B. This gives an image which shows how the system works, out from the equations directly, and out of the historical data also. One can be sure that the release of massive methane from the melting permafrost will force the Keeling curveupwards, perhaps with a *chaotic jump*. This may herald *Hawking irreversibility*.

CONCLUSION

Comparing the energy demand plans of major Asian economies with the COP21 TREATY de-carbonisation steps for this century, one notes the enormous difference. Something has to give. The Asian economic miracles are still in “catch-up” stage, betting upon economic growth to make them close the gap to the West (Barro, 1991; Barro and Sala-i-Martin, 1992, 1995). Global decarbonisation up until 2075 is a political myth.

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CO2 Emission Reduction With Solar
http://www.solarmango.com/in/tools/solar-carbon-emission-reduction

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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