International Journal of Social Science and Economic Research

ISSN: 2455-8834

Volume:03, Issue:05 "May 2018"

ASIA'S FUTURE AND CLIMATE CHANGE

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ABSTRACT

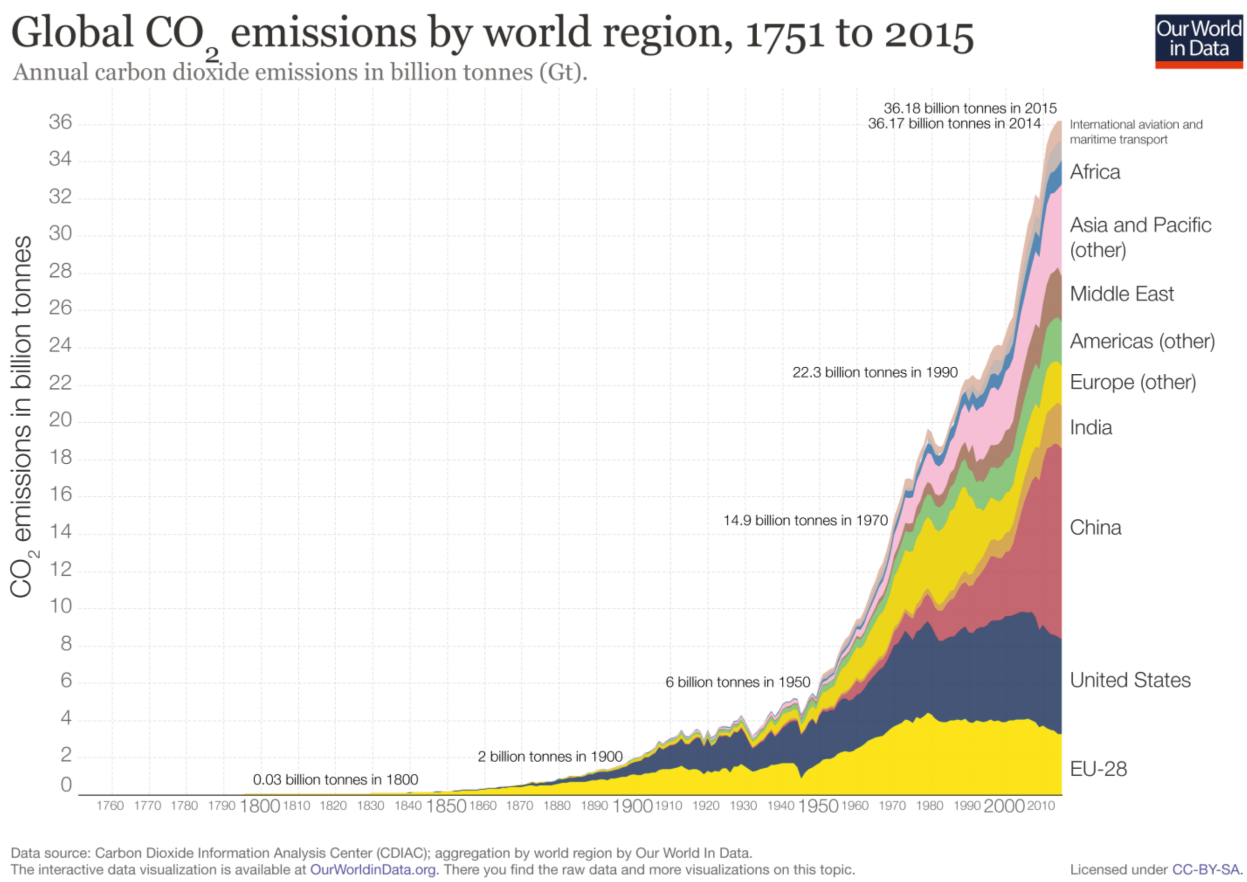
The Asian continent emits most CO2s in the world, reflecting its enormous economic advances in several countries. It is all based upon an enormous consumption of energy, especially fossil fuels, regarded as the only essential means to take Asia out of its historical poverty. Thus, poor nations in Asia imitated the miracle economies. With abrupt climate change coming, Asian governments must participate in global coordination against global warming – the COP21 project. And with the melting of the Arctic and the emergence of permafrost methane, this energy transformation is as urgent as its huge management.

Keywords: energy and affluence, CO2s, GHGS, COP21 project, solar power parks, abrupt climate change

I. INTRODUCTION

The Asian economic miracle is pushing ahead at full speed, with East, South East and South Asia becoming the dominant players in the global market economy together Pacific nation Australia. With fast population growth, these countries make economic growth the first priority, as to be able to raise affluence per capita and reduce poverty/ To succeed in this policy ambition, they need energy, very much energy. Relying upon fossil fuels, Asia has become the largest emitter of CO2s. In 2017, the governments of Asia's nations promised to conduct a radical de-carbonistion policy to halt climate change. Let us model this collision between economic growth and de-carbonisation for Asia, excluding the Arab world as well as Russia and the Khanates. Figure 1 shows how Asia became leading emissions region of CO2.

FIGURE 1. Region and CO2s



Now, the countries in the world have formed a common pool regime (CPR) to save the atmosphere from more GHGs, focusing only upon the CO2s. The global de-carbonisation plan in the COP21 Treaty includes:

i) Stall the rise if CO2s by 2020 (GOAL I);

ii) Decreasing the CO2s by 30-40% by 2030 (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? Will the Asian miracle economies implement them or will they renege in this giant *ocean PD game* (Prisoner's dilemma)? Only Japan has decreasing CO2 curves today.

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II. THEORY: Modeling GDP - Energy - Emissions

To grasp the complexity of climate change, one can make use of a few models that account for much of increase in greenhouse gases (GHG). Global warming further aggravated environmental destruction, but environmental degradation includes more than climate change,

a) Kaya Model

The basic model of carbon emissions is the so-called Kaya model, or Kaya's identity: Future carbon emissions depend on changes in Population (in billions), economic activity as GDP per capita (in thousands of $US/ person year), energy intensity in Watt years / dollar, and carbon intensity of energy as Gton C as CO2 per TeraWatt year." (http://climatemodels.uchicago.edu/kaya/kaya.doc.html)

It is proper to formulate it as a stochastic law-like proposition, where coefficients will be estimate using various data sets, without any assumption about stable universal parameters. Thus, we have this equation format for the Kaya probabilistic law-like proposition, as follows: (E2) Multiple Regression: Y = a + b1X1 + b2X2 + b3X3 + ... + btXt + u. Thus, using the Kaya model for empirical research on global warming, the following anthropogenic conditions would affect positively carbon emissions: (E3) CO2:s = F(GDP/capita, Population, Energy intensity, Carbon intensity),

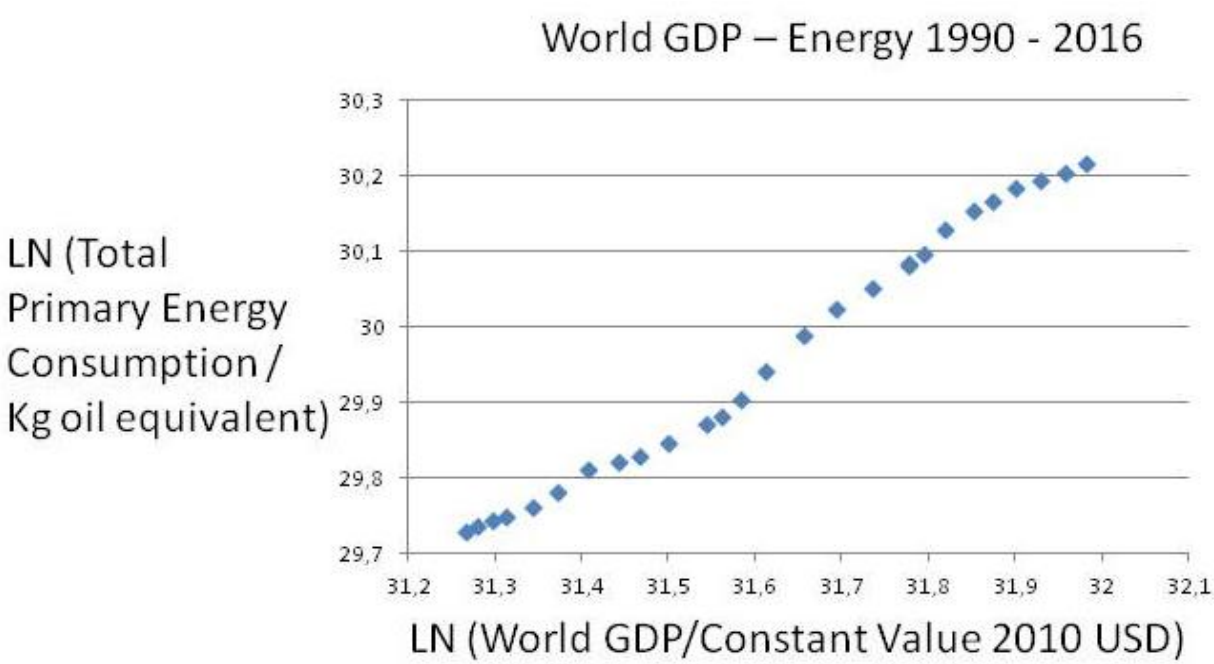
in a stochastic form with a residual variance. The Kaya model findings show that total CO2:s go with larger total GDP. An empirical estimation of the probabilistic Kaya model for 2014 points at GDP, and energy as keys:

(E4) k1= 0,68, k2=0,85, k3=0,95, k4=0,25; R2= 0,895.

Note: LN CO2 = 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)

Figure 2 shows the connection between GDP and energy for the last nearly 30 years. Energy comes in every sector in the economy and living standards cannot be raised without some form of energy.

FIGURE 2. GDP and energy 1990-2016



The enormous increase in energy is set to continue in the 21st century, as almost all governments aim for economic growth. De-carbonisation 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 3 shows the global connection between energy consumption and CO2 emissions.

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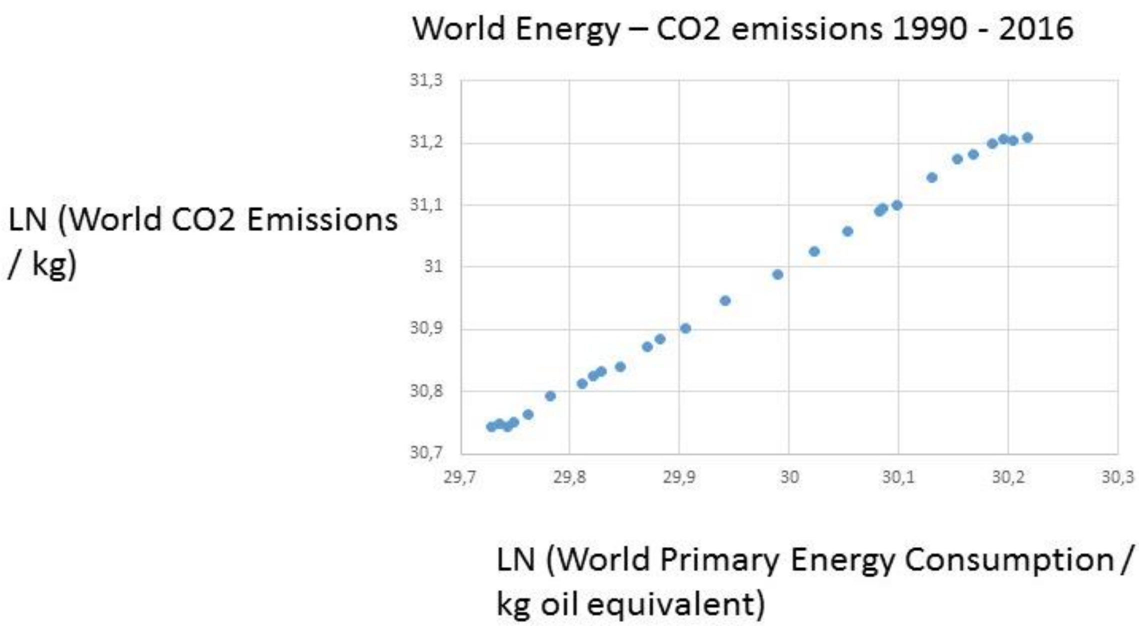
FIGURE 3. Energy and CO2:s: y = 1,01x; R^2 = 0,99



Source: BP Statistical Review of World Energy 2017, http://www.bp.com/statisticalreview; Janssens-Maenhout, G., Crippa, M., Gizzard, D., Mundane, M., Chaff, E., Olivier, J.G.J., Peters, J.A.H.W., Schure, K.M., Fossil CO2 and GHG emissions of all world countries, EUR 28766 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73207-2, doi:10.2760/709792, JRC107877

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 about one of its most vibrant parts:

Southeast Asia is also becoming a larger contributor to global GHG emissions, with the fastest growth in carbon dioxide emissions in the world between…. Deforestation and land degradation have been driving most of the emissions to date. ... Given the region's vulnerability to climate change, curtailing global emissions growth should be a priority consideration, to which the region can make an important contribution. (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 in this region.

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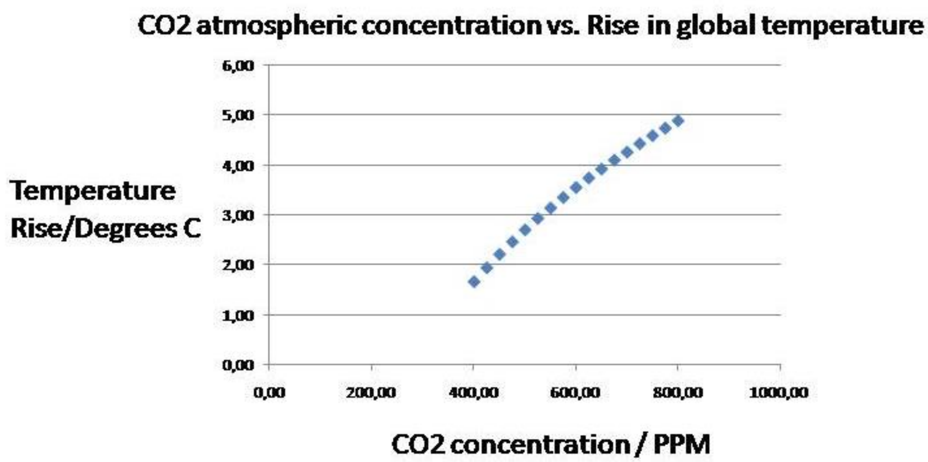
b) Keeling Model

The basic model of the relationship between emissions and temperature rise is the Keeling curve, but it only includes the CO2s of the GHGs. We employ the general formula: dT = λ*dF, where 'dT' is the change in the Earth's average surface temperature, 'λ' is the climate sensitivity, usually with degrees Celsius per Watts per square meter (°C/[W/m2]), and 'dF' is the radiative forcing. To get the calculations going, we start from lambda between 0.54 and 1.2, but let's take the average = 0.87. Thus, we have the formula (Myhre el al, 1998): Formula: (1) 0.87 x 5.35 x ln(C/280).

Diagram 1 shows how CO2 emissions may raise temperature to 4-5 degrees:

Diagram 1. CO2s and temperature rise in Celsius



The UNFCCC with its annual meetings have aimed at halting temperature rise at 1.5 degrees, but it will not succeed, because other GHGs are also augmenting (Prinn, 2013). Thus, 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.

c) Dieterlen Model

We shall use the methane concentration curve from mid-2013 to beginning of 2017 issued by NOAA ESRL https://www.esrl.noaa.gov/gmd/ccgg/trends_ch4/ , gently suggested by

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Dlugokencky and Kuniyuki. Why mid 2013? Because it is the last maximum of the second derivative before 2017. Since then, the curve is approximately linear, and we will derive its equation here under. Any decrease in methane concentration is very unlikely, as the main sources (in decreasing importance order) generally increase:

a) 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.

b) Wetlands emissions do not diminish yet, as the microbial chemical activity will increase with temperature for many years.

c) 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).

d) Biomass burning does not diminish; therefore the primary forest diminishes in the tropics, leading also to a decrease in animal, vegetate and cultural (Indigenous People) diversities and an increase in biosphere entropy.

e) Other natural emissions

The most important contribution to the recent rise of methane concentration is mainly due to the increase in activity by microbes, present in points a), b) and d) (Nisbet, in the above reference), 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 derive examples of future increase in methane concentration due to such a positive feedback, in addition to a linear approximation. For this, we will not simulate differential equations, which would be the best option, but 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.

The present (November 2017) quasi-linear curve starts mid 2013 (2013.5) and its ordinate is approximately 1813 ppb. We will use as a last value at start of 2017 (2017), and the function is approximately 1846 ppb. a straightforward calculation gives the slope: it is approximately 10 ppb/year. Therefore the equation for the future curve if there is no vicious circle (positive

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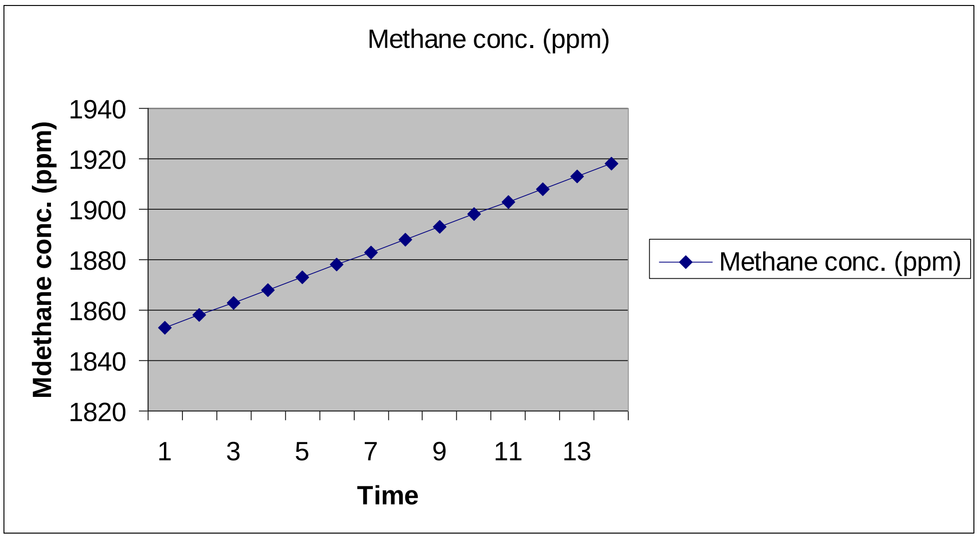
feedback) is: (2) y = 10 (t - 2013.5) + 1813, where t is the time when one wants to know the CH4 concentration, and y is the future CH4 concentration in ppb. From this equation, one can estimate the approximate the temperature rise due by methane, by applying to y the formula (1), and multiply it by 25. It will be valid for close future, but will probably be underestimated for farther future, where it will probably closer to an exponential.

Diagram 2. Projected increase in methane



d) Kuznets Model

Countries with lots of CO2 are big population countries with an advanced or emerging economy. Asia has more than the world population and these countries are determined to catch-up with the West.

Figure 4 shows that there is no Kuznets' curve (first rising, then descending) for CO2: richer countries emit more CO2 than poor ones. International aviation is a very major source of CO2 emissions, and it is booming.

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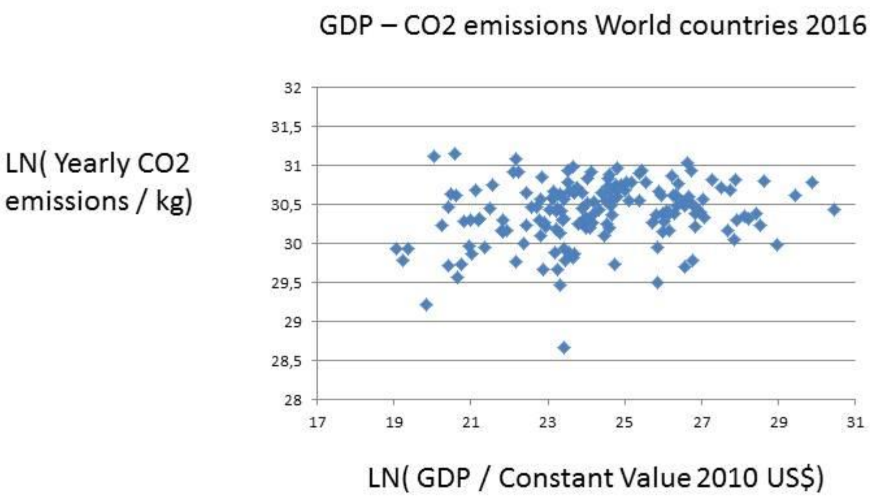
FIGURE 4. GDP-COP for all countries



The GHG emissions go with GDP growth, as the intermediate link is the ever expanding energy demand from GDP expansion. Several Asian economies are now either mature, catch-up or taking-off economies in terms of the classical models of GDP (Rostov, 1960; Barro, 1991; Barro, & Sala-i-Martin, 1992, 1995).

III. ASIA AND ENERGY

a) Surging Demand

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.

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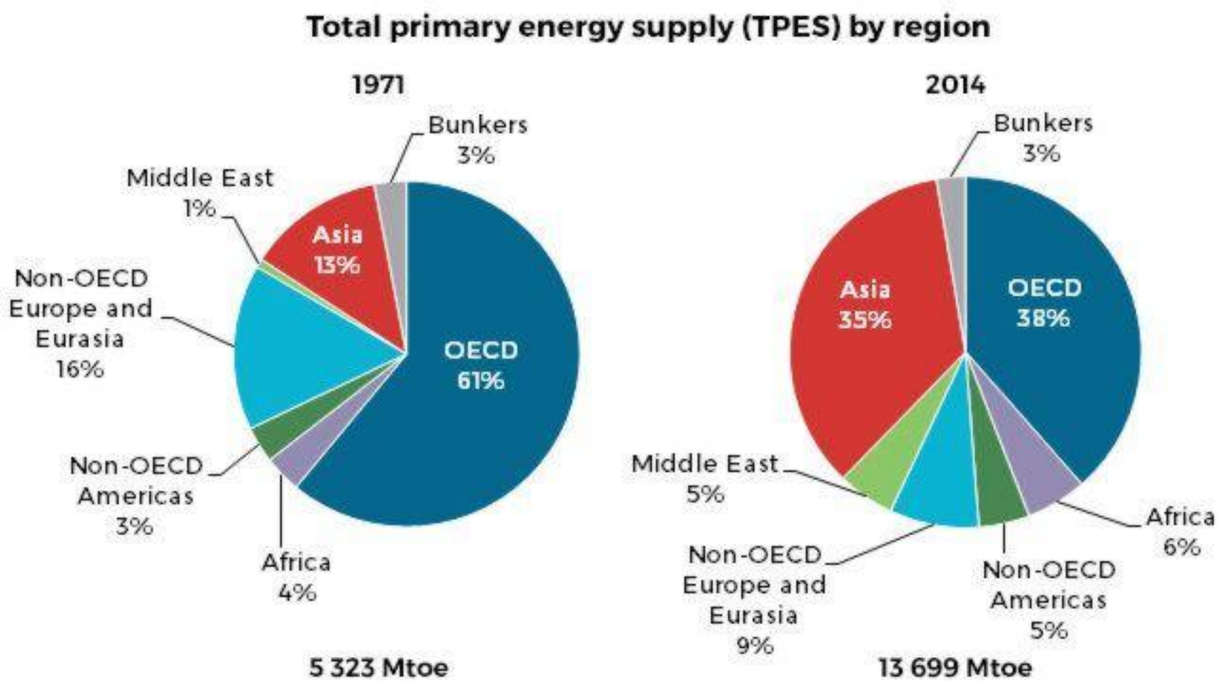
Since 1970, global energy consumption has more than tripped. And the share of Asia has increased phenomenally. The Asian economic miracle started in Japan after the Second War, spread to the four miracles – Taiwan, South Korea, Hong Kong and Singapore – only to include mainland China since 1980, in order to further widening to South East Asia and South Asia plus Kazakhstan as well as the Middle East oil and gas tycoons (Figure 5). 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.

FIGURE 5. Global Energy Consumption

(Source: https://www.iea.org/newsroom/news/2016/august/iea-data-shows-global-energy-production-and-consumption-continue-to-rise.html)



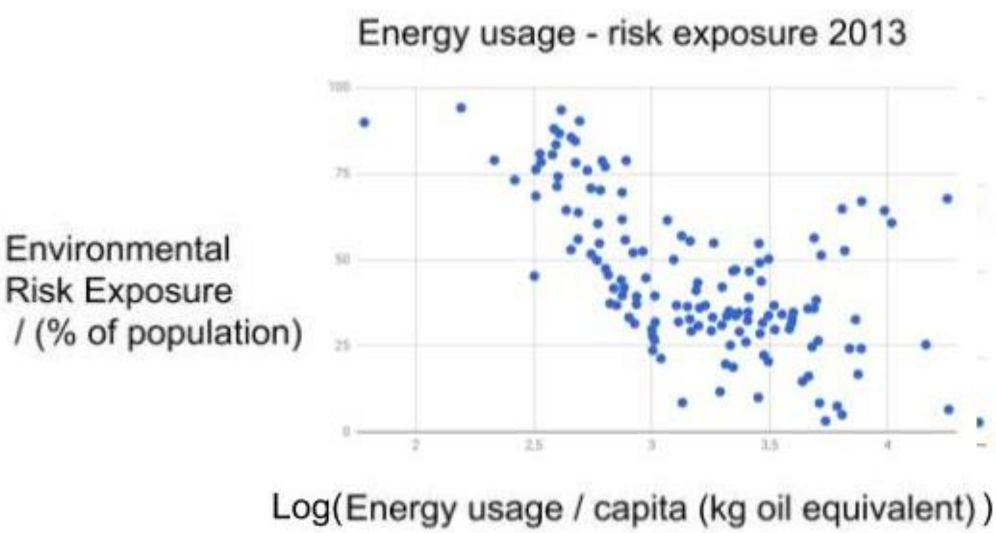
This economic revolution has made Asia harbour the set of factories of the world, thus increasing quickly affluence and wealth as well as succeeding in diminishing poverty. But energy transformation requires huge changes in Asia, like the elimination of coal as soon as possible.

b) Why so Much Energy?

The living conditions in the poor countries in Latin America, Africa and Asia as well as the Pacific reflects the low level of energy employed. This basic fact determines life opportunities in a most dramatic fashion. The low access to energy has consequences for the environment and the life situation of people, including health, schooling, work, food and potable water. Countries are poor because they have too little energy. And Asian countries know that only more energy can deliver the way out of poverty-

Energy deficit is conducive to a dire environment with enormous damages and risks. Consider the following global figures. Figure 6 shows how low energy leads to am unsafe environmental.

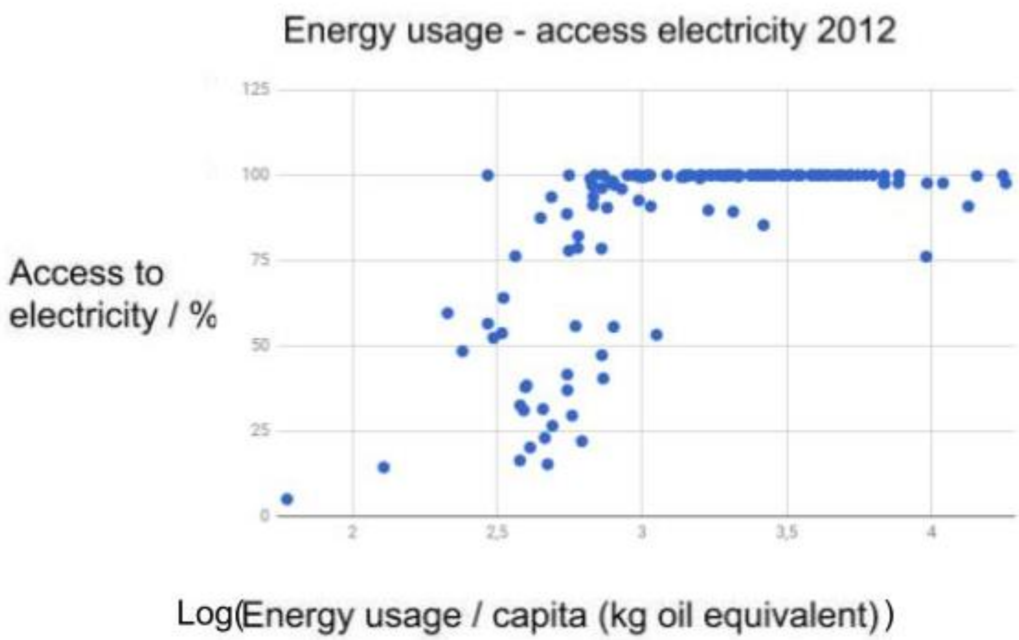
FIGURE 6: Energy and environmental risk exposure



Source: Environmental Performance Index, Yale University, https://epi.envirocenter.yale. IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/inde

Low energy use leads to poverty, malnutrition, deceases, lack of potable water, insufficient sanitation, etc. Typical of many Latin American, African and Asian nations is the lack of stable electricity, which hampers everything and reduces environmental viability. Figure 7 has the global picture.

FIGURE 7. Energy and electricity access



Source: Environmental Performance Index, Yale University, https://epi.envirocenter.yale. IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/inde

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 8 links energy with proper sanitation.

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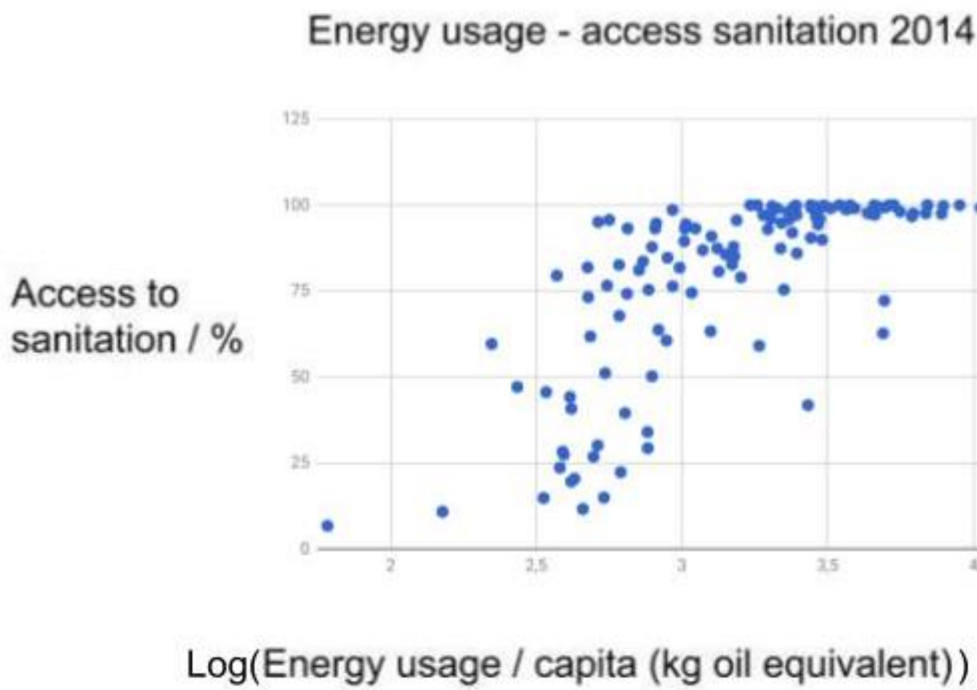
FIGURE 8. Sanitation and energy



Source: Environmental Performance Index, Yale University, https://epi.envirocenter.yale. IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index)

Especially, the rapidly growing African and Asian mega-cities lack entirely sewage plants. Thus, dirty water is put into the big rivers where other cities downstream take their potable water.

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 9 links energy with proper sanitation.

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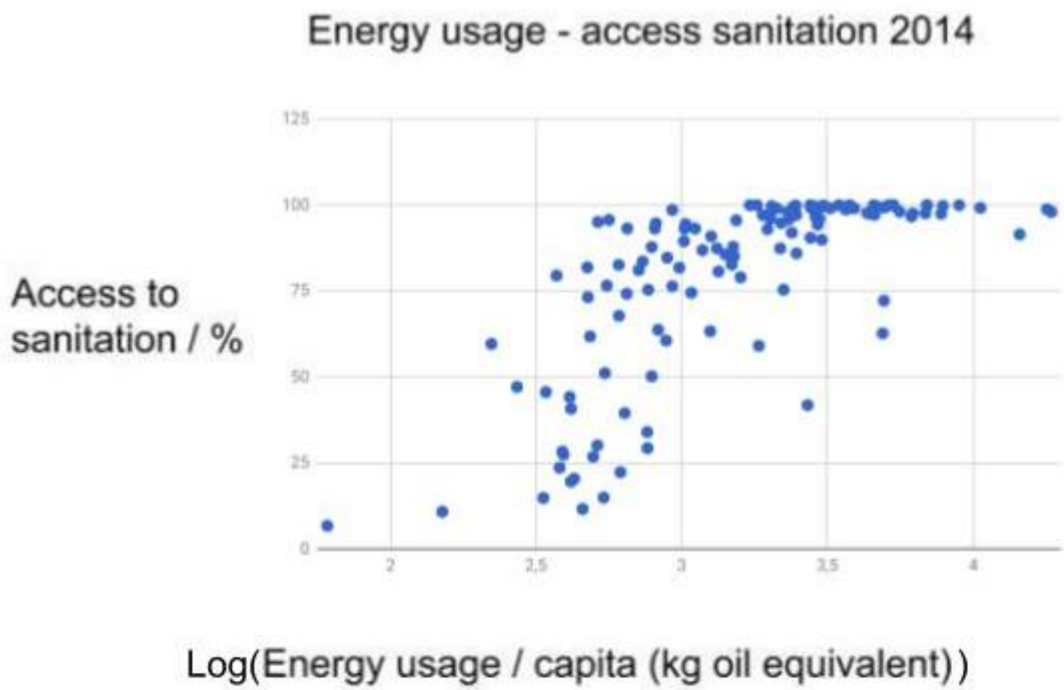
FIGURE 4. Sanitation and energy



Source: Environmental Performance Index, Yale University, https://epi.envirocenter.yale. IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/inde

Figure 10 underscores the necessity of more energy in poor countries.

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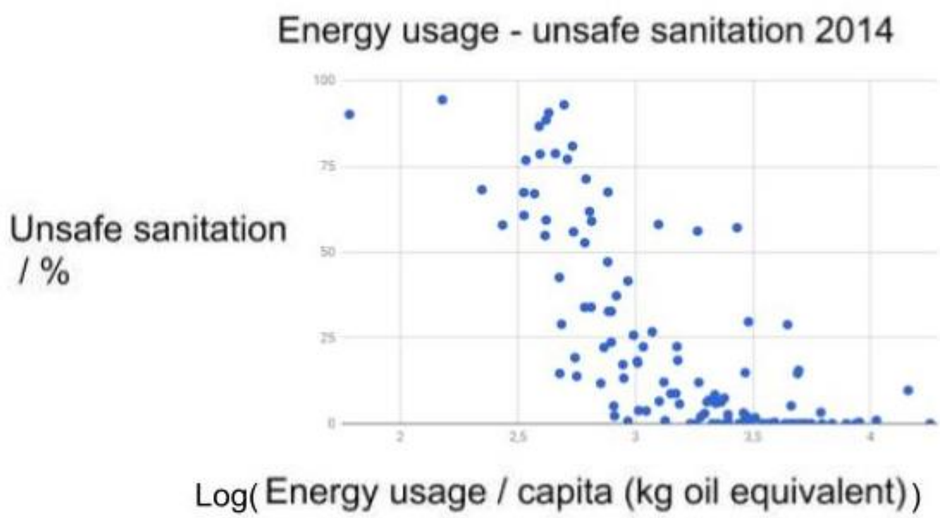
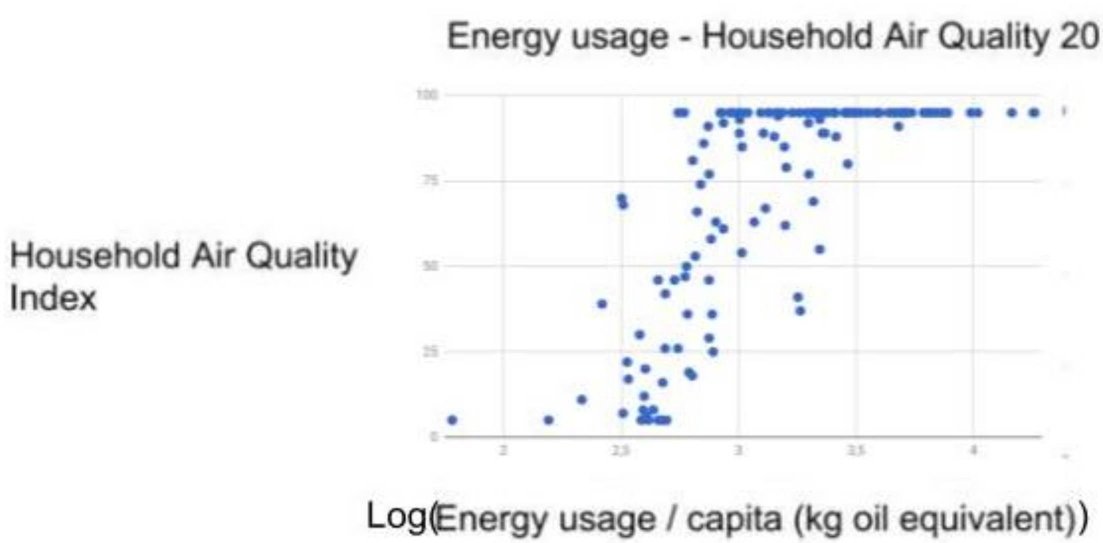
FIGURE 10. Energy and unsafe sanitation



Source: Environmental Performance Index, Yale University, https://epi.envirocenter.yale. IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/inde

Air quality too depends upon energy access (Figure 11).

FIGURE 11. Energy and air quality



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Source: Environmental Performance Index, Yale University, https://epi.envirocenter.yale.
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Typical of poor nations – Latin America, Africa, Asia - is the lack of stable electricity, which hampers work and reduces environmental viability. The access to safe electricity is crucial for health, schools, food, water, etc. Given the lack of enough energy in poor countries being conducive to the above bad living conditions, one understands the hopes of the poor countries for help with energy transformation leading to better access to just energy!

IV. MANAGEMENT STRATEGIES FOR DE-CARBONISATION

The UNFCCC suggests a decentralized management strategy for de-carbonisation. 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 COP24 in Poland 2018 may wish to concentrate upon the following measures start credible de-carbonisation:

1) Phasing out coal power plants now; 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;
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, 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 de-carbonisation 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

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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	
Indonesia	29	120	170	
Thailand	20 - 25[iv]	50	110	
Iran	4 – 12[iv]	22	220	
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:

1) The United States has pulled out of the deal; 2) No absolute target; 3) Pledge is above current level, no reduction; 4) Upper limit dependent on receiving financial support; 5) EU joint pledge of 40 % compared to 1990

V. ABRUPT 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 – deoxygenation killing fishing and local people livelihood. Can the chaos approach help analysis these drastic changes and their consequences?

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 does not 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 did not 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. One can be sure that the meltdown of Arctic ice and the release of massive methane from the melting permafrost will force the Keeling curve upwards, perhaps with a *chaotic jump*. This may herald *Hawking irreversibility*.

VI. CONCLUSION

Asian governments appear lukewarm about climate change coordination, making promises but not taking action on a grand scale. They know how important energy supply is to for socio-economic policies. China is again increasing CO2s and India clings to coal or charcoal (Ramesh, 2015). Energy transformation, closing down coal power and building solar power parks, is a necessary condition for maintaining affluence and further reduce poverty on the Asian continent. Abrupt climate change with meltdown of the Arctic and release of methane will raise temperatures to 5-6 degrees Celsius. Millions and more will die in Asia.

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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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