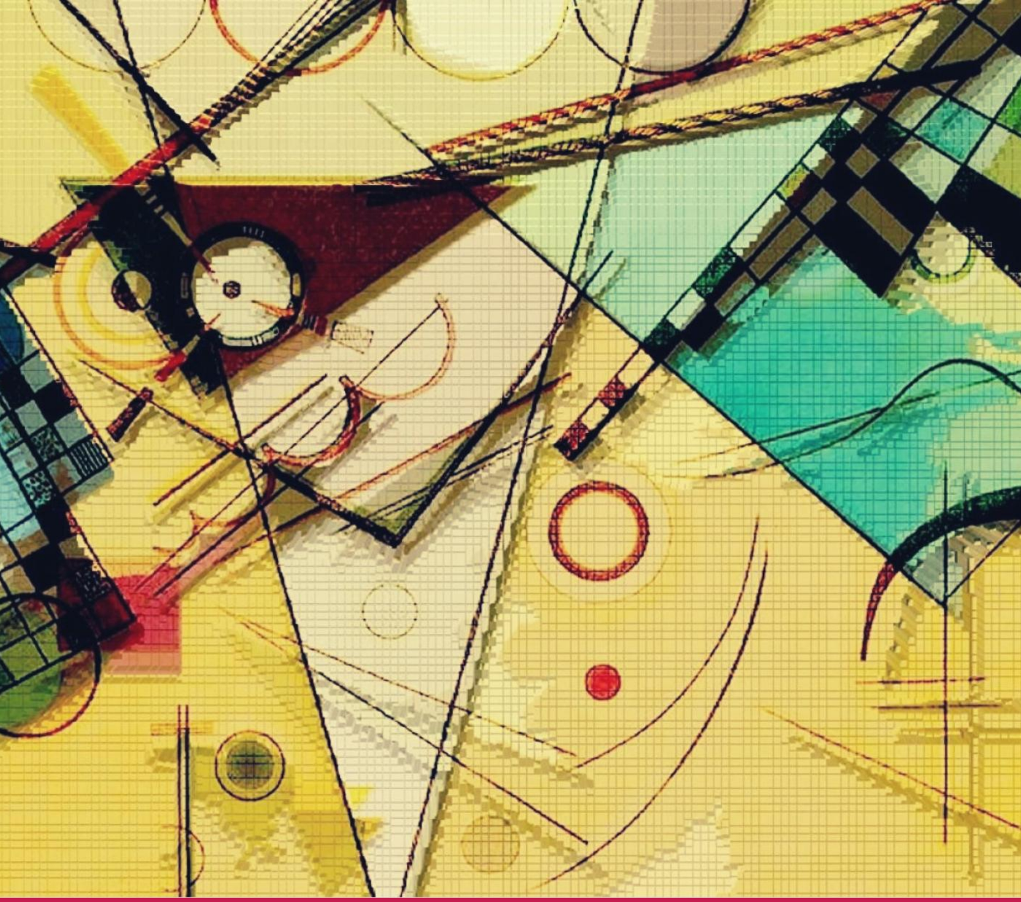

JAN-ERIK LANE

GLOBAL WARMING

Carbon emission, global warming and the political economy of energy

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***Global Warming:** Carbon emission, global warming and the political economy of energy*

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Foreword

I came across global warming for the first tite at a visit to late Aaron and Mary Wildavsky in their Oakland home around 1990. When I raised concern about the future and climate change, the Wildavsky couple reacted strongly, telling me that it was just the Mother of all scares. If environmentalism was more political ideology than merely science - the cornucopian thesis - than how could I be so wrong?

The second time I encountered global warming was during my stay at Fiji Islands where I taught development. I noticed that environmentalism had to be given a much higher priority in state and society. Environmental policy was far more than the hidden agenda of the Left with the Cornucopians. It offers indeed the only way to save the islands from massive litering.

When I settled down in Burma in my wife Mimi'S apartment I began writing small pieces on global warming rather than general environmentalism; as the evidence pointed in one clear direction concerning the former. My first finding was that global warming and energy is practically inseparable, making climate change unstoppable or irreversible The second finding from reading the global warming debate recognised that a social science perspective simply did not exist. The reason that international cooperation on a Common Pool Regime like the Paris Agreement fails is that global warming presents an Ocean PD game, translating into endless transaction costs.

I apologize for several repetitions from one piece to another, reflecting the urgency of speaking out against the cornucopian rejection of global warming. This collection of papers I dedicate to my Burmese companion into the period of climate change.

J.E. Lane
Sweden
April 15, 2020

Contents

1 Global warming: Preventing irreversibility

Introduction

What international governance in the United Nations Framework Convention on Climate Change – UNFCCC project aims at together with global state coordina- tion is to engage in decarbonisation while securing economic development. The COP21 objectives are: GOAL I: Halt CO2 increases by 2018-2020; some countries already have done so, but far from all; GOAL II: Reduce CO2 emissions by 30-40 per cent, depending on how counts, by 2030 – an immense challenge; GOAL III: Complete decarbonisation by 2070-2075.

As world star physicist Stephen Hawkins recently remarked: global warming is close to becoming irreversible. The theory of global warming could not be more relevant for mankind, as irreversibility entails human extinction. French mathema- tician Joseph Fourier discovered global warming in the early 19th century, but the theory was developed by Swedish chemist Arrhenius around 1895. He calculated that a doubling of CO2 ppm would be conducive to a 5 degree increase in global average temperature, which is not too far off the worst case12 scenario for the 21rst century, according to UN expertise now.

Yet, it was not until Stephen Schneider published Global Warming in 1989 that the theory started to receive wide attention, no doubt strengthened by the work of Keeling in measuring CO2 ppm globally. Moreover, techniques for viewing the CO2 layer were developed, increasing the attention to climate change.

Now, the UN reacted with creating a few bodies to look into the changes going on, one of which was the COP framework. The economists jumped in besides the natural scientists, worried about the future costs of this transformation of the at- mosphere. On the one hand, Kaya and associates presented in 1997 a model that explained CO2:s with energy and energy intensity of GDP. On the other hand, Stern called global warming the largest externality in human history, calling for interna- tional governance in order to stem the growth of greenhouse gases. Stern outlined in 2007 a number of activities aimed at reducing CO2 emissions, promising also a Super Fund to channel money from rich advanced nations to poor countries and developing economies. As little has been done through the UN system of meetings and agencies – transaction costs – up to date, Stern 2015 asked: "What are we waiting for?", neglecting his promise of the Super Fund (Ramesh, 2015).

Dangers from anthropogenic climate change

Considering the probable damages from global warming, it is astonishing that global warming theory has not been better recognized or even conceptually devel- oped or empirically corroborated. There will be sooner or later:

Huge land losses along the costs;

Too high temperatures for men and women to work outside;

Food production decline;

Fish harvest decrease;

Droughts and starvation;

Lack of fresh water supply;

Drying up of rivers, affecting electricity supply;

Ocean acidification and species extinction;

Highly volatile climate with storms, rainfall and tornados with tremendous damages;

Deforestation and desertification;

Great damage to the poles and mountain glaciers.

This list is far from complete or exhaustive. One could even mention worse outcomes, like the transformations of warm and cold currents in the oceans – Gulf Stream, North Atlantic Current for example. What one may underline is that so far no known negative feedback has been found that could stem global warming nat- urally. We seem to have mainly only positive feedbacks, meaning outcomes rein-force each other in the same direction. The situation in the Amazons and Borneo is basically "lost", and Siberian forests threatened.

Energy – environment conundrum

Basically, roughly 90 per cent of all energy consumption comes from non-re-newables. The COP21 call for decarbonisation involves a sharp reduction of fossil fuels up until 2030 in order to stabilize climate change with a 30-40 decrease in CO2 emissions. First, we see that CO2 emissions are closely connected with energy consumption, globally speaking. And the projections for energy augmentation in the 21st century are enormous (EIA, BP, IEA).

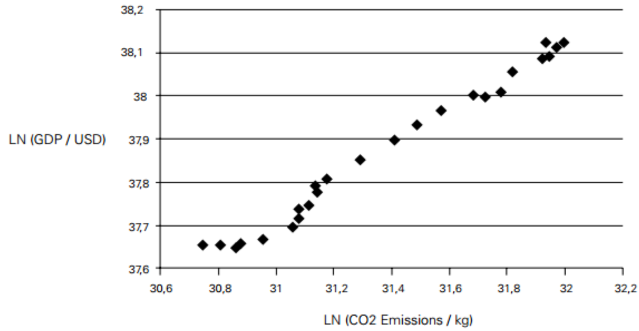

Figure 1. *Global GDP-CO2 link: $y = 0{,}4092x + 25{,}03$, $R^2 = 0{,}987$ (N =26)*
Source: BP Statistical Review of World Energy 2017, [Retrieved from].; EDGAR. European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR), release version 4.3.2. [Retrieved from]. Janssens-Maenhout, *et al.*, 2016. World Bank Data Indicators, [Retrieved from]. British Petroleum Statistical Review of World Energy 2016

The findings show that total GHG:s or CO2:s go with larger total GDP, i.e., GDP per person population. Decarbonisation is the policy promise to undo these inks by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy. Thus, the upward sloping curves must be reversed but still slope outward. As, total energy consumed rises, so CO2:s increase. Secondly, energy means power and consequently affluence and wealth. It is hotly desired by men and women in today's world, as Figure 2 entails.

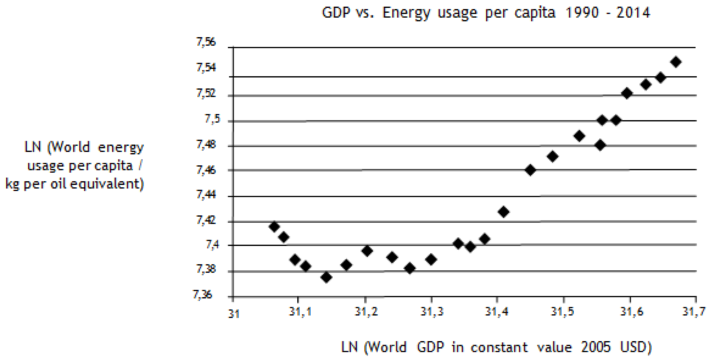

Figure 2. *Energy consumption per capita globally*

Source: World Bank national accounts data – data.worldbank.org; OECD National Accounts data files; World Resources Institute CAIT Climate Data Explorer – cait.wri.org; EU Joint Research Centre Emission Database for Global Atmospheric Research. [Retrieved from]. International Energy Agency. Paris: Energy Information Administration. Washington, DC. British Petroleum Statistical Review of World Energy 2016

With such a demand for energy, resulting in sharply rising CO2:s per capita, how is mankind to avoid the horrendous consequences of climate change? One solution is the vast economic depression with strong cut backs in energy consump- tion, but no governments will deliberately choose this alternative, as it entails mass poverty and starvation deaths.

The COP21: Implementation of goal II

Let us first focus upon what this hoped for reduction of fossil fuels implies for the augmentation of renewable energy consumption, here solar power. The use of atomic power is highly contested, some countries closing reactors while others construct new and hopefully safer ones. I here bypass wind power and thermal power for the sake of simplicity in calculations.

Consider now Table 1, using the giant solar power station in Morocco as the benchmark – 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. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: Global scene (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/%of2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
United States	26 – 28[2]	2.100	3.200
China	None[3]	0	3.300
EU28	41 – 42	2.300	2.300
India	None	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Canada	30	230	300
Mexico	25	120	200
Australia	26 – 28	130	190
Russia	None[4]	0	940
World	N/A	N/A	16.000

Source: UN Framework Convention on Climate Change: CO2 Emission Reduction With Solar. [Retrieved from].

Notes: 1) The United Sates has pulled out of the deal; 2) The United States of America made this pledge but has subsequently withdrawn from the agreement; 3) No absolute target; 4) Pledge is above current level, no reduction.

If countries rely to some extent upon wind or geo-thermal power or atomic power, the number in Table 1 will be reduced. The key question is: Can so much solar power be constructed in some 10 years? If not, Hawkins may be right. Thus, the COP23 should decide to embark upon an energy transformation of this colos- sal size.

Solar power investments will have to take many things into account: energy mix, climate, access to land, energy storage facilities, etc. They are preferable to nuclear power, which pushes the pollution problem into the distant future with other kinds of dangers. Wind power is accused to being detrimental to bird life, like in Israel's Golan Heights. Geothermal power comes from volcanic power and sites.

Let us look at the American scene in Table 2.

Table 2. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: American scene (Note: Average of 250 – 300 days of sunshine per year was used for Canada, 300 – 350 for the others).*

Nation	CO2 reduction pledge/% of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Canada	30	230	300
Mexico	25	120	200
Argentina	None[3]	0	80
Peru	None[3]	0	15
Uruguay	None[3]	0	3
Chile	35	25	30

Note: [3] No absolute target.

It has been researched has much a climate of Canadian type impacts upon solar power efficiency. In any case, Canada will need backs ups for its many solar power parks, like gas power stations. Mexico has a very favourable situation for solar power, but will need financing from the Super Fund, promised in COP21 Treaty. In Latin America, solar power is the future, especially as water shortages may be expected. Chile can manage their quota, but Argentine needs the Super Fund for sure.

Table 3 has the data for the African scene with a few key countries, poor or medium income.

Table 3. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: African scene (Note: Average of 300 – 350 days of sunshine per year was used).*

Nation	CO2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Algeria	7 – 22[5]	8	50
Egypt	None[3]	0	80
Senegal	5 – 21	0,3	3
Ivory Coast	28 – 36[5]	2	3
Ghana	15 – 45[5]	1	3
Angola	35 – 50[5]	6	7
Kenya	30	3	4
Botswana	17	1	2
Zambia	25 – 47[5]	0,7	1
South Africa	None[3]	0	190

Notes: [3] No absolute target.; [5] Upper limit dependent on receiving financial support.

Since Africa is poor, it does not use much energy like fossil fuels, except Maghreb as well as Egypt plus much polluting South Africa, which countries must make the energy transition as quickly as possible. The rest of Africa uses either wood coal, leading to deforestation, or water power. They can increase solar pow- er without problems when helped financially.

Table 4 shows the number of huge solar parks necessary for a few Asian coun- tries. The numbers are staggering, but can be fulfilled, if turned into the number ONE priority. Some of the poor nations need external financing and technical as- sistance.

Table 4. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II. Asian scene (Note: Average of 250 – 300 days of sunshine was used for Kazakhstan, 300 – 350 days of sunshine per year for the others).*

Nation	CO2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Saudi Arabia	None[3]	0	150
Iran	4 – 12[5]	22	220
Kazakhstan	None[3]	0	100
Turkey	21	60	120
Thailand	20 – 25[5]	50	110
Malaysia	None[3]	0	80
Pakistan	None2	0	60
Bangladesh	3,45	2	18

Notes: [3] No absolute target; [5] Upper limit dependent on receiving financial support.

Finally, we come to the European scene, where also great investments are needed, especially as nuclear power is reduced significantly and electrical cars will replace petrol ones, to a large extent.

Table 5. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: European scene (Note: Average of 250 – 300 days of sunshine per year was used)*

Nation	CO2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Germany	49[6]	550	450
France	37[6]	210	220
Italy	35[6]	230	270
Sweden	42[6]	30	30

Note: [6] EU joint pledge of 40% compared to 1990.

Is there space to build all these solar parks, one may ask. But many small houses with solar roofs will also do well. Public buildings and company offices may be run on solar power from their roofs! Innovation is needed everywhere.

Conclusion

As the Keeling curve continues its relentless rise (Earth CO2), we must take Hawkins warning about irreversibility seriously. Moving now and up to 2030, ac- cording to the COP21's GOAL II for decarbonisation eliminates irreversibility. The solution is solar power parks of Ouarzazate type size. Above is a calculation of what is needed in many countries around the world, taking into account the insights of the research into GDP-energy-emission links. Time has come for halting and reducing CO2 emissions by real implementation and not utopian dreams of a sus- tainable economy (Sachs, 2015). There is nothing to wait for any longer (Stern, 2015), as the COP23 must set of the promised Super Fund. No time for politicking in the UN any longer (Conca, 2015; Vogler, 2016). A few days before the start of the UN global environment reunion COP23 (6-13 November 2017) in Bonn, the major study Climate Science Special Report: Fourth National Climate Assessment (USGCRP, 2017): was published in Washington. It examines the global warming problematic from the point of view of the US and the world, based upon years of research by a large group of US scholars. It renders an impressive list of climate change impacts upon the US territory and points decisively at human causes. We must then ask: Can really a set of global decarbonisation policies be implemented or managed? 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 reducing local peoples' livelihood. Ex- amining energy consumptions prediction, one observes that energy is expected to double by 2050. There will be renewable energy for sure, but there is no global decarbonisation predicted by the stylized projections. Perhaps new energy demand will be satisfied by renewables, but the old carbonization structure of energy con- sumption will remain, so it seems?

Appendix

The so-called Kaya model runs as follows:

(E1) Kaya's identity projects future carbon emissions on changes in Popula- tion (in billions), economic activity as GDP per capita (in thousands of $US(1990) / 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)

Concerning the equation (E1), it may seem premature to speak of a law or identity that explains carbon emissions completely, as if the Kaya identity were a deterministic natural law. It will not explain all the variation, as there is bound to be other factors that impact, at least to some extent. Thus, it is more proper to formulate it as a stochastic law-like propo- sition, 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 proba- bilistic law-like proposition, as follows:

(E2) Multiple Regression: $Y = a + b1X1 + b2X2 + b3X3 + ... + btXt + u$

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

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).

I make an empirical estimation of this probabilistic Kaya model with a longitudinal test for 1990-2014, i.e., World data 1990 – 2015: (E4) Ln CO2 = 0,62*LN Population + 1,28*LN(GDP/Capita) + 0,96*LN(Energy/GDP); R2 = .90.

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2 Climate change is not only GHGs but also economics

Introduction

The new theory of abrupt climate change, speaking of the risk of tipping points conducive irreversible global warming – a "hotspot Earth", is based on the model of a game against Nature from game theory. The future would hold two states: survival versus extinction for humanity. And two policy responses would cover on the one hand global coordination and country resilience on the other hand. Thus we have:

Table 1. *Climate change as a game against Nature*

		Nature	
		Human survival	Human extinction
Policy response	Global coorcination	A= P1 x U1	B= P2 x U2
	Country resilience	C= P3 x U3	D= P4 x U4

The COP21 Treaty is hopefully an example of A, but the probability of success is very uncertain, as B is still possible depending on how COP21 is implemented up to 2030. Countries like for instance the USA may opt for resilience, C, hoping it can develop own measures against the downplayed consequences of global warming. However, the likely outcome of country resilience is D, it seems according to several climate and earth scientists.

Holoscene, anthropocene and nature's revenge: Less degrees of freedom

Social action, interaction as well as social system build upon the degrees of freedom that the environment, DNAs and the Universe provide humans with. These degrees of freedom were increased during the industrial revolution up to now. In the recent inquiry into climate change, "Trajectories of the Earth System in the Anthropocene", the hope of distinguished authors is tied to halting climate change. Despite dire warning about the future dismal state of Planet Earth threatening human survival, the authors state that the COP21 promises may save mankind, as long as they restrict global warming to + 2 degrees Celsius. I quote:

> "The beginning of the industrial revolution around the late 18th century is sometimes proposed as a start date for the Anthropocene …. Its importance as the beginning of large-scale use by humans of a new, powerful, plentiful energy source – fossil fuels – is unquestioned. Its imprint on the Earth System is significant and clearly visible on a global scale. However, while its trace will remain in geological records, the evidence of large-scale shifts in Earth System functioning prior to 1950 is weak. Of all the candidates for a start date for the Anthropocene, the beginning of the Great Acceleration is by far the most convincing from an Earth System science perspective. It is only beyond the mid20th century that there is clear evidence for fundamental shifts in the state and functioning of the Earth System that are (1) beyond

> the range of variability of the Holocene, and (2) driven by human activities and not by natural variability." (David, 2018).

Yet, the Anthropocene period is coming to its end, as Nature's revenge works itself out in the ferocious positive feedback loops of global warming – the so- called tipping-points. Typical of today's realities is the accelerating helplessness of governments and state towards the tipping-points and their consequences threating to make Planet Earth a hot spot with much less land for humans. Thus, the degrees of freedom are shrinking.

I quote this much discussed report again:

> "…greenhouse gases are still rising rapidly, threatening the stability of the climate system, and tropical forest and woodland loss remains high. The pursuit of growth in the global economy continues, but responsibility for its impacts on the Earth System has not been taken. Planetary stewardship has yet to emerge. Will the next 50 years bring the Great Decoupling or the Great Collapse? The latest 10 years of the Great Acceleration graphs show signs of both but cannot distinguish between these scenarios, or other possibilities." (David, 2018).

If GHGs are such a formidable threat to human survival (50% of the story), what is that drives forth this abrupt climate change with its positive feedback? Reply: Energy demand and supply, meaning economics (50% of the story).

The industrial revolution: Progress and energy

The idea of progress was born with coming of the many innovations during the 18th and 19th centuries. Perhaps Scottish enlightenment played a crucial role for the thought that human life and the social systems of men and women could be improved year in and year out, endlessly. "Paradise" could be accomplished here on Earth promised the new ideologies, replacing religion, when industry and urban dwellings started to replace agriculture and rurality.

The confidence in machines was boundless, as with Karl Marx. Yet, they needed the new form of energy, namely fossil fuels first coal, then oil and finally now massive amounts of natural gas. As the industrial revolution took the form of the adoption of the institutions of modern capitalism, early warnings about tensions between profitability and environmental sustainability were launched, by Marxists and egologists.

Yet, the greenhouse effect from the emission of CO2s was first formulated in a succinct manner by Swedish chemist Arrhenius around 1900, though already French mathematician Fourier anticipated the insight. Not until the 1990 was there a general recognition that fossil fuel consumption would lead to global warming on a scale that threatened humanity.

The insights of people like Keeling, Sawyer, Schneider and Hansen inter alia run against mainstream economic theory after 1945, emphasizing the necessity of economic growth for human progress. Of particular importance was the notion of "take-off", launched by Rostov in 1960. To raise affluence, countries must experience the time point when capitalist developments take off spontaneously. In Asia, state led measures attempted to simulate the take-off point. National income would start growing in combination with urbanization and industrialization, lifting millions out of poverty. Global economic growth would provide all nations in the market economy with a decent level of human development, or a set of human capacities. The so-called Washington Consensus underlined economic freedom and liberalization of trade and investments. The sooner the take-off, the more likely there would occur catch-up by the Third World. But all of this required one thing, cheap energy.

In rich countries with an economy in balance more or less, domestically and internationally, the Baptiste Say perspective upon economic motivation entails the idea of balanced economic growth, supported strongly by financial markets. Even if real economic growth fluctuates, the emphasis upon yearly economic growth is typical of modern capitalism or the market economy, but so far it has necessitated a constant augmentation of energy. Figure 1 shows the tight relation between affluence and energy consumption.

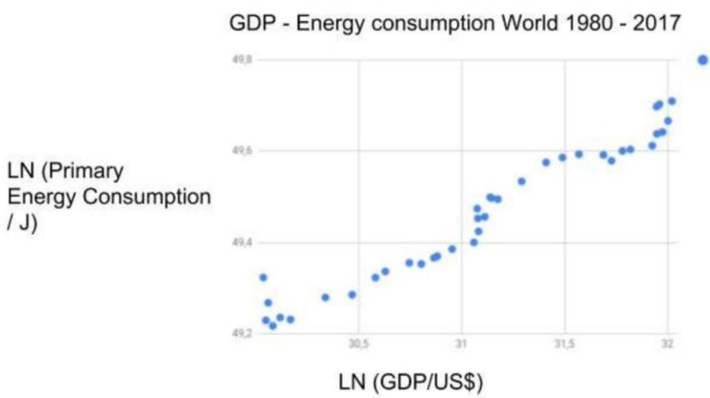

Figure 1. *Affuence and energy globally*
Note: R2 = 0.951
Sources: BP Statistical Review of World Energy. World Bank Data Indicators

The enormous demand for more and more of energy comes with a major drawback, namely the GHG emissions. Figure 2 has the picture for the carbon intensity of energy, resulting in CO2s.

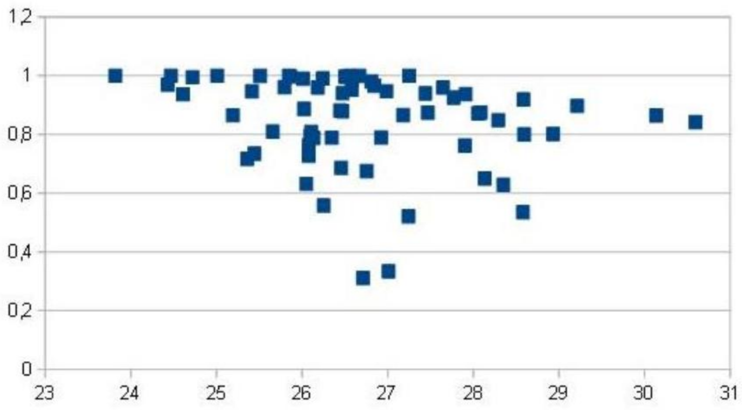

Figure 2. *Carbon intensity of energy (fossil fuels/all energy)*

Very few countries score under 50 per cent: Norway and Sweden as well as South Africa, but several countries score 100% or close: The Gulf States, Algeria, former Soviet Union states ("Stans"), Turkey, Mexico, etc.

This enormous expansion of energy supply of fossil fuels has made part of the world's nations rich. They want to hold on to this progress and even deepen it. And the poor countries are driven by the ambition to "catch-up" when they have managed to "take-off". Energy is key in this strategy, also using fossil fuels.

Energy and the Third World

Most people on Planet Earth lives in poor or developing countries. Their life chances depend upon access to cheap energy. One may relate the standard indicators in the UN developmental index to energy access in order understand the claim of the Third World that COP21 suggested decarbonisation must not lead to a new energy shortage.

Figure 3 displays how environment hazards decline with energy supply. This is country resilience with other words against inundation, storms, etc.

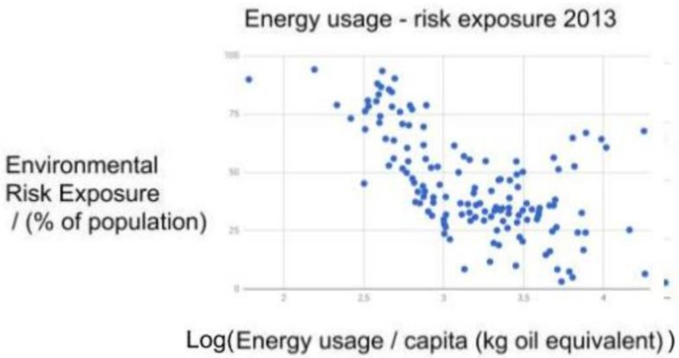

Figure 3. *Energy and environmental risk exposure*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 4 has the global picture about the necessity of more energy supply.

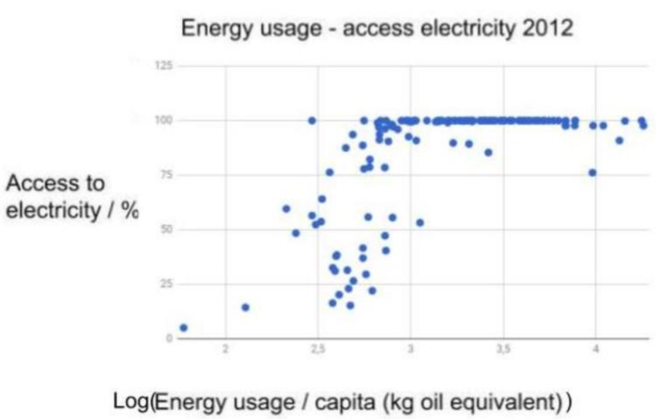

Figure 4. *Energy and electricity access*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 4 links energy with proper sanitation. Especially, the rapidly growing African, Latin American and Asian mega-cities lack entirely proper sewage plants. Thus, dirty water is put into the big rivers where other cities downstream take their potable water. Figure 5 links energy with proper sanitation.

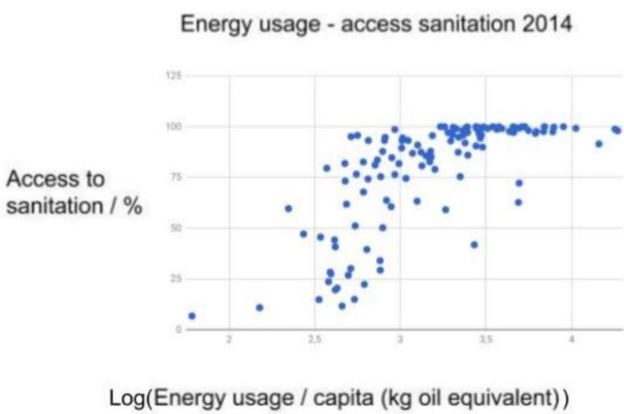

Figure 5. *Sanitation and energy*

Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Figure 6 underscores the necessity of more energy for proper sanitation, without which the life of humans is "salle".

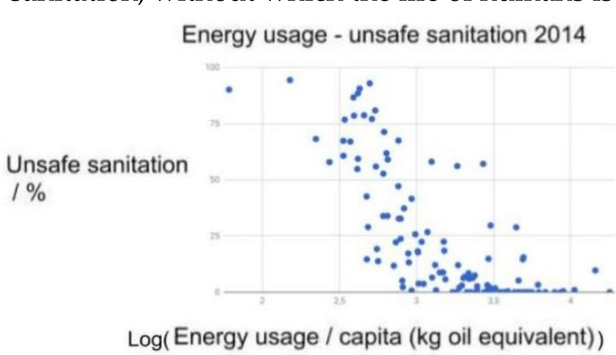

Figure 6. *Energy and unsafe sanitation*

Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Air quality too depends upon energy access (Figure 7).

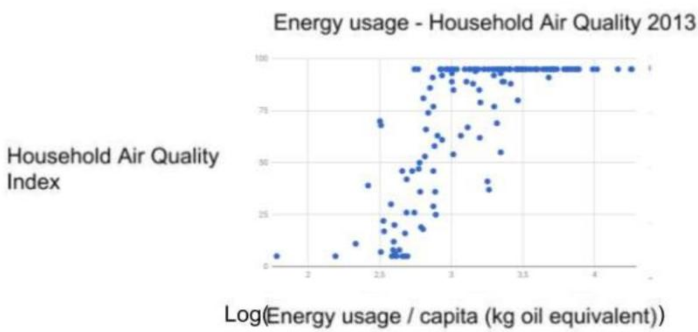

Figure 7. *Energy and air quality*

Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Bad or dangerou air to breed is found in most big Third World cities. Againt intolerable heat, the use of air conditioners has spread around globe, requiring electricity. It is a positive feedback, increasing GHGs.

Water

The most essential ingredient in human life situation is access to potable water, for drinking and for food production. Yet, energy shows up here too – see Figures. Without water, mass starvation.

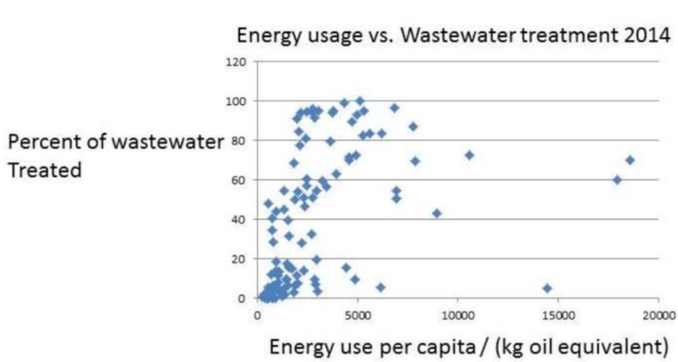

Figure 8. *Water I*

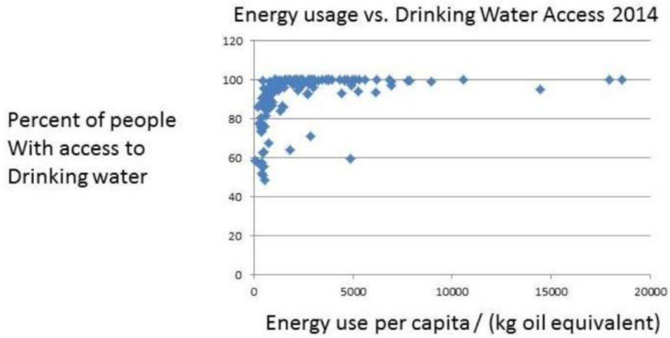

Figure 9. *Water II*

To Sum Up: Energy consumption crops up everywhere in processes of economic growth in rich countries and socio-economic development in poor nations. If decarbonisation is not to lead to economic retrogression, then lots of investments and innovations are necessary, and time is tight. One understand Ramesh (2015) saying that India can only accept COP21 decarbonisation, if its energy demand is somehow satisfied, meaning billions of support for enery transition to keep socio-economic development on track.

What strategies of decarbonisation are realistic economically speaking?

As the basic cause of global warming is the GHGs, an energy transformation from fossil fuels to renewables or nuclear power is necessary. But how to transform the global economy? Since the CO2s remain for hundreds of years in the atmosphere, decarbonistion must entail complete elimination of coal, oil and natural gas. It could be done by forbidding the economy to employ fossil fuels, with mass unemployment and economic depression as consequence, albeit only a theoretical possibility.

Take the air transportation industry as an example. The increasing airline industry pollutes like the giant polluter countries, but a shut-down would make millions unemployed. The same holds for ocean and sea transportation.

Conceivable, one faces the following alternatives to conduct decarbonisation:

Laissez-aller

Even though 193 governments agreed to the Paris COP21 Accord, it remains today much business as usual. Will its tempo of decarbonisation be followed and will it be enough to stall climate change. Very uncertain. It is true that several countries conduct various decarbonisation plans, but it is hardly coherent policy. Thus, some countries close nuclear power plants, others build giant dams despite water shortages and several plan for new mega projects that require much more energy. CO2s have still not leveled off. A few countries bet on natural gas like the US and South Korea. Coal has been reduced but far from eliminated. The airline industry keeps growing.

Global coordination

The CO withP21 Treaty is what will start from 2020 in a slow pace, ending in 2075 with "complete" decarbonisation.The COP Treaty also falls under the model of a common pool regime (CPR). CPRs are based upon promises among a group of actors or players concerning the regulation of the use of a common resource, typically in scarce supply. According to Ostrom' analysis (1990), CPRs rely upon self-policing. She focussed upon domestic CPRs mainly, and downplayed too much the indirect role of the state. But we find CPRs in international relations, where there is no third party Umpire who can play the role of Hobbes' illuminating judge, enforcing contracts or promises:

"Covenants, without the sword, are but words and of no strength to secure a man at all." Now, will the COP21 work as

the CPR that saves mankind? Or will governments abstain from opportunistic behaviour, reneging upon their promises? Probably NOT. Why? Because the value of the game is tremendously important, namely energy. Hawking irreversibility is *practically* sure, as massive decarbonisation is highly improbable. Some government will defect upon COP21 as a PD game (Dutta, 1999).

Country resilience

Countries may trust their own capacity to face the consequences of climate change, or underestimate the force of what will come, like the US. Yet, resilience may work for big countries with many resources. Most countries have little resilience and much rely upon global coordination.

Several countries engage in precaution, protecting itself against sea level rise, forest fires, rain storms with flooding and mud and land-slides. Some also cut back fossil fuels, or promise to so do more than committed in the COP21 approach. There are carbon taxes and markets for emission rights in a few countries.

But the CO2s keep increasing for 2017 and 2018. In addition, there is methane bomb. The objective of plus 2 degrees Celsius is opaque, as Planet Earth is heading for more and even plus 1 degree Celsius could be lethal due to the enormous positive feedback lopes released now.

Building levies, drilling deeper ever for potable water, building desaliensation plants and promoting renewables would be much more effective, if there were a global coordination plan, like the COP21 Agreement. But this stumbles upon the ocean PD game inherent in all coordination of this type.

Cooperation or defection in ocean games or ocean clubs

The COP21 Treaty, or any other similar agreement, would have two parts: i) reduction of CO2 emissions ina certain pace towards zero emissions at some future date; ii) contributions to the Super Fund yearly according to some scheme and time table.

Both these two actions concern first and foremost the countries in the G20 group of nations, responsible for 70 per cent of the total CO2 emissions. Small poor nations can be left beside, as they pollute little and cannot be required to pay into the Super Fund.

Both i) and ii) are just promises, which the COP21 Secretariat or the UN cannot enforce, strictly speaking. When a country receives support the Super Fund, there is some leverage to force obedience. However, a big poor country may simply refuse decarbonisation, if no assistance is provided.

Decarbonisation is costly in the short run for all countries, as the must replace existing energy plants with new, hopefully renewable energy resources. Contriuting to the Super Fund is also costly in the short run. This sets up an interaction where a government may be tempted to defect from its promises to decarbonise or pay to the Super Fund.

A. Stratey of poor nations: the N-1 problematic. Poor or small nations will engage in opportunism with guile in order to avoid too large costs with the COP21 decarbonisation policy, pretending they matter very little for outcomes.

B. Strategy of the rich country: the 1/N problematic. Large or rich countries will find sacrifices that cannot be internalised as meaningless gifts to others, who may not be trusted to cooperate. Thus, the US reneged because it did not want to pay for decarbonisation in India.

Demand and supply of energy

Climate and Earth scientists have informed daily about the severe positive feedback from global warming. They point out that the cause if the emission of GHGs, especially, which must be halted and decreased quickly. Yet, the rooy cause of the climate change drama is the constantly increasing thurst for energy in the social systems of human beings. Though the rise in energy supply has been phenomenal during the recent twenty years, the G20 nations plan for ever stronger augmentation in energy demand. Renewables enter this demand increase but not much decarbonisation is in the cards.

Conclusion

Only three measures can halt climate change, namely:

1) Immediate stop to coal and charcoal;

2) Quick replacement of oil and natural gas with solar power and wind power – see Table 1;

3) Large scale effective geo-engineering.

Table 1. *Number of Ouarzazate plants for 40 per cent reduction of CO2 in some giant countries (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
United States	26-28	2100	3200
China	None	0	3300
EU28	41-42	2300	2300
India	None	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Australia	26-28	130	190
Russia	None	0	940

Germany	49	550	450
France	37	210	220
Sweden	42	30	30
World	N/A	N/A	16000

Note: 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. But the G20, responsible for more than 70%of CO2 emissions, seem to continue following the track in Figure 10. Renewables increase, yes, but energy supply goes faster.

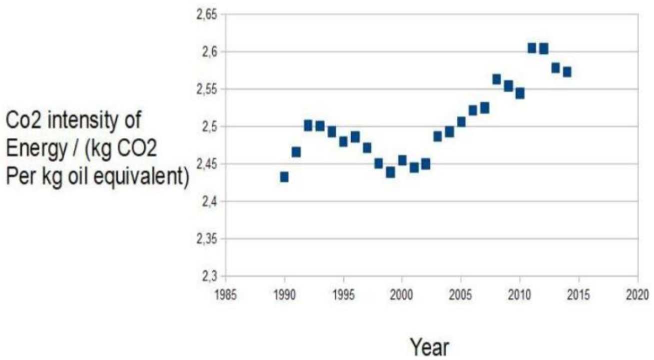

Figure 10. *World Co2 intensity of energy 1990-2014*
Source: Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States.

As economist Stern (2007, 2015) argues, climate policy coordination is most urgent.

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3 Is global management of anti-global warming policies at all feasible?

Introduction

It is emphasized by the natural sciences that the increase in the greenhouse gases (GHG) in Earth' atmosphere is due to human causes, as the emission of GHGs from nature has remained stable since the start of the industrial revolution. Several kinds of GHGs exist, but the UNFCCC has concentrated upon the CO2s in their coordination efforts to halt GHG increases in the COP21 project. Other GHGs like for instance methane and NO2 are more potent in their greenhouse effect, but occur in less quantity today.

Global government coordination has come so far that the UN has enacted the policy objective of almost complete decarbonisation in this century at the COP21 reunion in Paris 2015. But can this formidable objective to be managed? Let us consult the social sciences concerning big policy implementation as well as about international coordination.

Can the increase in GHGs be stopped before the so-called Hawking irreversible point, where climate chaos become unstoppable? To ponder about the question, so fatal for humanity, we need a theory about what is achievable by policymaking and international coordination.

Policy and management: Climate chaos or economic crisis?

As we get more and more dire predictions about the nature of climate change and its probable consequences, it becomes more and more urgent to clarify what the COP project can and must accomplish. Climate change could be halted by a sharp reduction in the use of fossil fuels over night, but it would spell large scale economic crisis with mass unemployment and social upheaval.

Many climate experts now claim that we are heading for more than a + 2 Celsius increase in global warming as well as already a + 2 Celsius augmentation is a threat to human survival due to the many positive feedback loops started by such an increase. As the doomsday scenarios gather strength, it becomes absolutely vital to stick to the COP project and explore what can be achieved and how.

The overall objective of the COP21 project from Paris 2015 is to start decarbonisation by 2020 and finish it by 2075. A necessary condition is that states conduct energy policies that eliminate coal and start solar power parks. This requires enormous management skills by individual governments with support from global coordination agencies or committees.

A drastic policy tool is carbon sequestration or capture, but it is hardly viable at the moment. Climate engineering may add to the basic means: abolition of coal and big solar power parks.

Logic of policy implementation or management

The debate about big project implementation or management was initiated by Max Weber around 1900, suggesting his means-end framework:

> "All serious reflection about the ultimate elements of meaningful human conduct is oriented primarily in terms of the categories "end" and "means." We desire something concretely either "for its own I sake" or as a means of achieving something else which is more highly desired. The question of the appropriateness of the means for achieving a given end is undoubtedly accessible to scientific analysis. Inasmuch as we are able to determine (within the present limits of our knowledge) which means for the achievement of a proposed end are appropriate or inappropriate, we can in this way estimate the chances of attaining a certain end by certain available means. "(Weber, 1922, 1949: 54–55).

According to Weber, human behaviour is to be understood by an inquiry into the intention or motivation, a mental concept that is decomposed into means and ends. An action is rational when an actor decides upon the most effective means for realising his/her goals by enhancing outcomes. This teleological mode of analysis fit humans especially, as they haw the mental capacity to calculate. Often an end when fulfilled is a means to a further goal, i.e. we have meansend chains.

Do such intentions – means-end chains – work in the sense of rationality or effectiveness? Rational decision-making excludes unrealistic objectives and errors in the calculation of means. The COP21 project is an example of rational decision-making where mankind is the supposed actor:

a) End: halting global warming at + 1,5 or 2 degrees Celsius;

b) Means: decarbonisation, achieved around 2075;

c) Intermediate means:

i) stopping the increase in CO2s in 2020;

ii) reducing CO2s totally by around 30% up to 2030;

iii) voluntary approach by each state with weak oversight but economic assistance from a Super Fund.

Does the Paris 2015 satisfy the criteria of rational decision-making, namely: realistic objectives, consistent preferences, correct causal belief in the relationship between means and outcomes, maximisation of probability X utility over all alternatives and outcomes? The main schools of policy implementation and management have replied as follows.

Bounded rationality (H. Simon)

Simon would have had no difficulties in rejecting the COP21 project as not fitting the rational decision-model. He would point out the cognitive limitations in the project:

a) No comprehensiveness: COP21 bypasses one major GHG, namely mathane. If lots of methane are released in the Arctic, COP21 will fail no mater what;

b) Ambiguity of objectives: what is the sense of "decarbonisation" when no specific targets are set in absolute numbers that are observable and verifiable?

c) Absence of control mechanisms like oversight, incentives (positive or negative) and mere promises without sanctions.

Simon argues that only bounded rationality or restricted decision-making is feasible, both for single individuals and organisations or groups. Especially organisations pursue "standard operating procedures", according to March, meaning simplifications of the requirements of full rationality, as laid down by the neo-classical decision model in economics.

As a matter of fact, the arrival of abrupt climate change makes the COP21 project already outdated.

Implementation gap (Wildavsky)

Scholars with the discipline of public administration follow the teachings of A. Wildavsky about an inescapable gap between policy ex ante and implementation ex post. Implementation theory was developed for national policy-making with finding of a major gap between blue-prints in the centre and implementation failure at the local or regional levels. Policy-makers engaging in nation wide programs face bounded rationality. Thus, each and every national policy includes uncertainty and has to be adapted or changed locally.

The same policy – implementation gap applies to international relations where coordination efforts are not only hampered by bounded rationality but also the restrictions from public international law, especially the principle of state sovereignty.

The COP21 Treaty may have been a great leap forward from one point of view, namely environmentalism as philosophy, but the entire COP21 project face enormous implementation difficulties, as policies are vague and management lacking.

Organised chaos (March and Olsen)

In the theory of organisations, one has been very interested in the possibility of groups of people to engage in rational action, like the governments of the world setting up a plan for global decarbonisation. The answer is that individual rationality may be feasible at the micro level, but large organisations with many decision-makers must fail at the macro level. There will be simply too much conflict, confusion, mistakes, lack of consistency over time ‑ in one word chaos. In organised collective action, leadership is luck, preferences changing and information biased.

Judging the COP21 Treaty from the perspective of March and Olsen, launching their conception of government as organised chaos, one may have serious doubts about the implementation of the COP21 project. A promise is made of giant money in a Super Fund, but how to fund it? Global decarbonisation is set out in three main stages, but it is a too slow process with many loopholes. And the conflicts among states are deep concerning which countries should do the most and contribute the most to the Super Fund.

Reneging or cheating

Even if one accepts that the COP21 project is rational or semi-rational decision-making (clear preferences, reasonable technology), game theory would warn that it is wide open to strategic behaviour and asymmetric information. It does not matter it is micro level or macro level choice, as both individual and collective decision-making can be cheated upon by reneging upon promises.

The COP21 Treaty is nothing but a paper with promises for a very long time and with enormous practical consequences. Why deliver upon it? Energy transformation is costly and affect ordinary people. When costs go up, maybe defect from promises made a time ago? Or demand a hefty compensation from the Super Fund?

The paradox of the famous PD game lies at the core of the COP21 project. It is rational for each single participant in the common pool regime (CPR) to defect hoping that the others will deliver (N-1 problem) or to delay contributing because the benefits will be shared by others (1/N problem). The US has already reneged because the Trump administration does not to contribute to the Super Fund or India's decarbonisation costs. As the COP21 project moves along, there will be many opportunities for defection, especially as the PIL sanctions this.

International society versus anarchy of states

The COP21 Agreement enters public international law, when it has been ratified by the UN member states. Scholars have held great hopes about the PIL, restraining state sovereignty. But it is only forcing governments when it comes to the questions of war and peace, where the Security Council rules if unanimous. Rule of rule in an international society has not yet accomplished, meaning that several treaties of PIL can be reneged upon, like the COP21 Treaty. Governments tend to first and foremost act upon national interests, even when it foes against international norms.

Why in the first place is there such an enormous demand for energy, especially during recent decades?

Energy demand in a wide sense

I suggest we analyse energy in a wide sense. The need for energy is obvious in all the human sources of GHGs – see Figure 1.

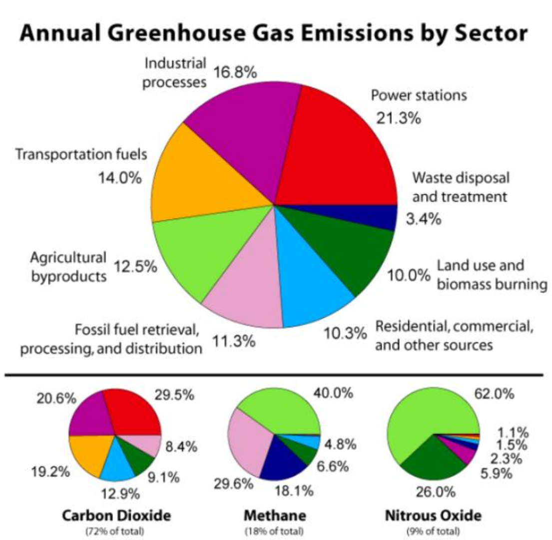


Figure 1. *Human sources of GHGs, globally*

What Figure 1 shows is that the GHGs stem from all vital sectors of society, not merely energy production itself must be underlined that GHG emissions are a function of GDP and population. Only very big poor countries have huge GHG emissions, like India, Brazil and Indonesia. Small poor nations have little GHGs, as they lack energy in great quantity.

Yet, poor countries wish to participate in saving the planet from the dangers of climate change on the condition of financial assistance from the COP project and its Super Fund.

Yet, energy is the capacity to do work. And work is the source of human welfare. The growth in energy consumption since the industrial revolution and especially after the Second World War has been just immense, especially the supply of fossil fuels. In poor countries, the demand for energy is huge for economic development, whereas rich countries are heavily dependent of fossil fuels for economic growth. Why demand for energy when resulting in so much CO2s?

Positive Consequences of Energy Access

The majority of countries in the COP project are in poverty, as they need more energy. Thus, they can only decarbonise
when renewable energy sources become available. This is the redistribution task of C0P21.

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.

African countries are poor because they have too little energy. Thus, they have much less GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydro power depends upon water availability that shrinks with global warming.

African energy deficit is conducive to a dire environment with enormous damages and risks. Consider the following global figures. Figure 2 shows how low energy leads to am unsafe environmental.

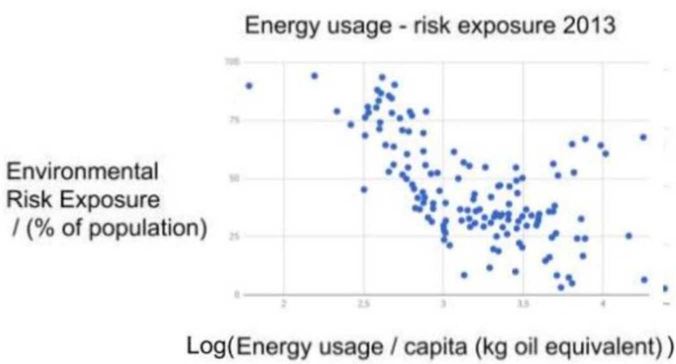


Figure 2. *Energy and environmental risk exposure*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 3 has the global picture.

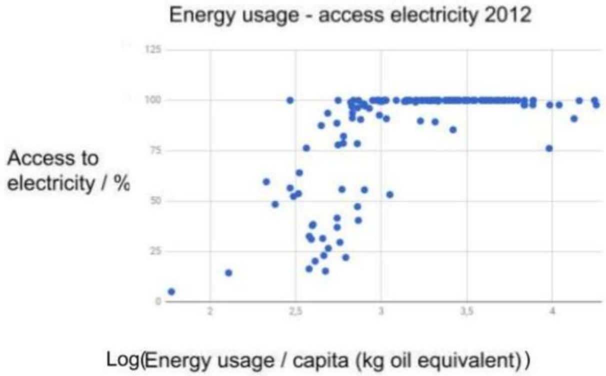


Figure 3. *Energy and electricity access*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 4 links energy with proper sanitation.

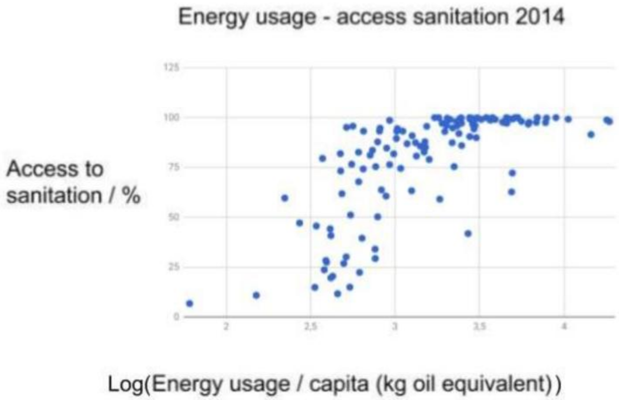


Figure 4. *Sanitation and energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 4 links energy with proper sanitation.

Figure 5 underscores the necessity of more energy in poor coutries.

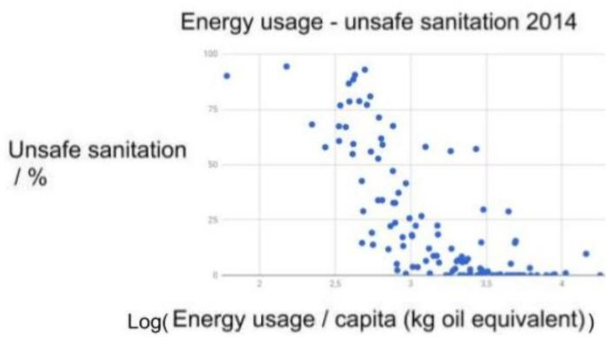


Figure 5. *Energy and unsafe sanitation*

Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Air quality too depends upon energy access (Figure 6).

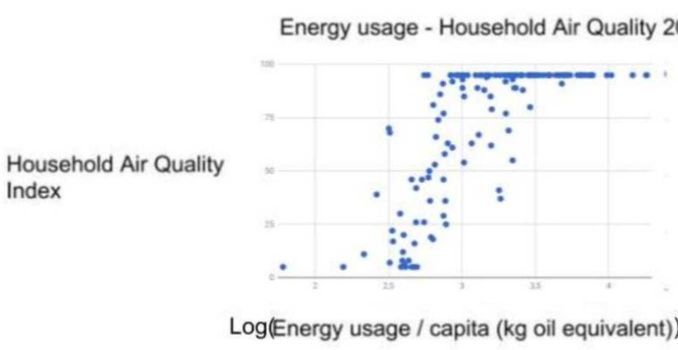


Figure 6. *Energy and air quality*

Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Typical of many 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.

In terms of GHGs, rich countries have much higher levels of yearly emissions compared with poor countries, holding population constant. Only when a poor has an enormous population is it a big CHG polluter.. Strict linear relation hold between GDP, energy consumption.

If, as we believe, energy consumption is behind global warming, the set of poor countries face a most difficult dilemma. On the one hand, they can demand much more energy like fossil fuels, but they then contribute much to climate change, On the other hand, global warming while fabricated by the rich nations and a few very populous poor nations, will have very negative consequences for poor nations. The only way out of this dilemma is that all countries contribute to halting global warming by turning to renewables, especially the set of rich countries.

Thus, energy consumption is closely related to country affluence. The poor countries can only improve living condition by increase energy supply. Their energy demand can only go up, because energy supply is highly skewed to the advantage of the rich countries – see Figure 7.

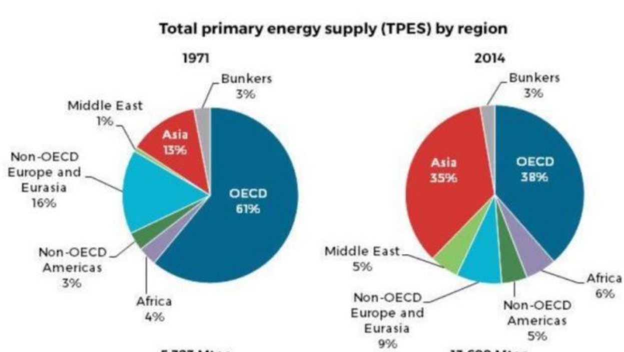


Figure 7. *Global Energy Consumption*

Poor countries need much more energy, but of a new kind. They need assistance to move to modern renewables, as they will give up fossil fuel only if there is compensation by other new energy sources. Let us take a few examples of energy planning for the future by core states. Can they handle the consequences of climate change by themselves – the resilience strategy, advocated by disbelievers in global coordination.

Can resilience work?

Let us explore below whether the key countries are moving or planning to move in this decarbonisation direction? Each single country has its energy consumption pattern that must be taken into account in both domestic and international energy supply transformation.

India

In Indian energy policies, it is emphasized that developmental goals take precedence over climate change considerations. Thus, all Indian household must have access to electricity and only sustained rapid economic growth can reduce poverty. India has a "take-off" economy that delivers affluence for the first time since independence. But it is based on fosil fuels. India looks into other sources of energy, as long as socio-economic development is not hindered. Figure 8 shows the main features of future planning.

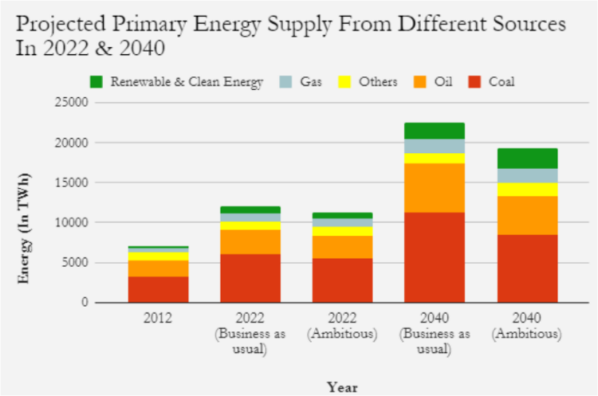


Figure 8. *India`s energy future*
Source: [Retrieved from].

India has rapidly become a major CO2 emitter due to its high growth rates since 1990. It uses lots of coal, stone or wood. Charcoal is bad for households and results in forest destruction. India tries to broaden its energy supply to modern renewables, like solar, wind and hydro power. Yet, it will remain stuck with fossil fuels for decades. It needs assistance from the COP21 project, especially for solar power parks. Building more dams is very risky, as global warming reduces water assets. Figure X indicates the India cannot meet its COP21 promises.

Brazil

Brazil is a "catch-up" with its "take-off" point long ago in the 20th century.. Compared with India, but it never really succeeds to close the gap to North America, tumbling now and then into dictatorship or recession. Figure Y shows its stylised energy plans – are they in agreement with COP21 hopes of decarbonisaton?

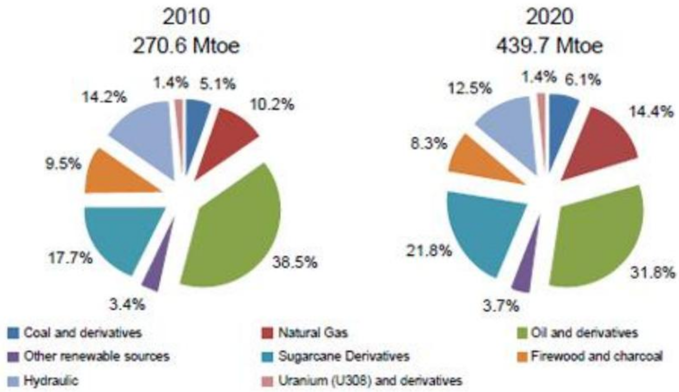
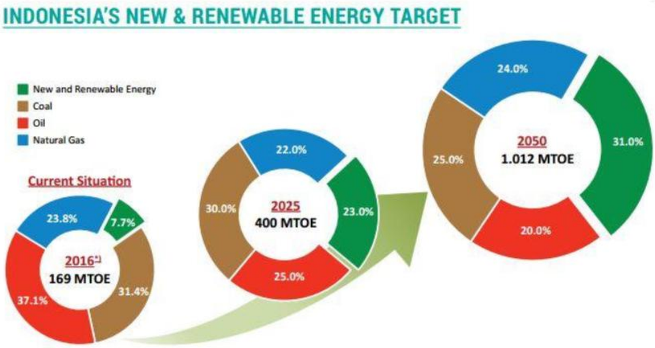


Figure 9. *Energy plans in Brazil*
Source: [Retrieved from].

Brazil has already a diversified supply of energy. However, since the country plans to almost double its energy supply, its dependence upon fossil fuel will grow, also upon coal. It dreams about building many more dams in the Amazons, but future water shortages due to climate change may make these plans unrealistic. The country needs COP21 assistance to turn to solar power massively, in order to eliminate first and foremost coal and charcoal. The rain forest is part of Brazil' s emission picture where burning and logging reduce its carbon uptake.

Indonesia

Indonesia is like India a "take-off" country, enjoying rapid economic growth with attending augmentation in energy consumption. The outcome is that this giant nation has quickly become a major GHG emitter. What make the situation worse is the burning down of the rain forest in parts of Indonesia.



	2016	2025	2050
NRE Mix	7.7 %	23%	31%
Energy Supply	169 MTOE	400 MTOE	1.012 MTOE
Generation Capacity	59 GW (NRE 8 GW)	136 GW (NRE > 45 GW)	443 GW (NRE > 167 GW)
Electricity/Capita	956 kWh	2.500 kWh	7.000 kWh
Electrification Rate	91%	~100%	~100%

Figure 10. *Energy future for Indonesia*

Indonesia`s energy augmentation plan is way beyond global decarnnisation plans.

USA

The US has reduced its CO2 emissions during the lats years, mainly by a shift to natural gas. Actually, several mature economies have been able to halt the rise of CO2 emissions, either by more energy efficiency or a shift to natural gas or renewables. Figure 11 captures some features in US energy plans.

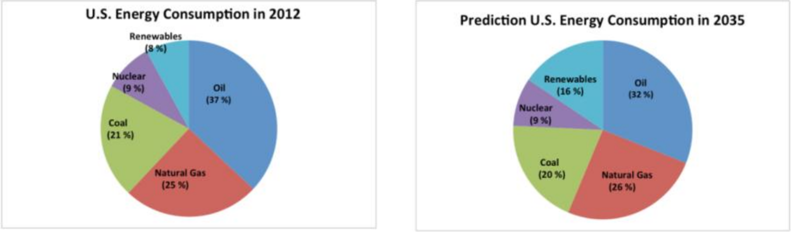


Figure 11. *US energy future*
Source: [Retrieved from].

Although the Figure 12 predicts a doubling of renewable energy, the dependency upon fossil fuels, including coal energy, will not bee much reduced. We are talking here about relative numbers, but if the US increases total amount of energy supply, then there may even be more fossil fuels. The reduction in CO2s during recent years seems to be coming at a reduced rate. The hope is for economic growth without energy increases, but we are not there yet. And most countries demand more energy for the future. China now enters the First World, as it has long passed its "take-off" point in time around 1980 and has pursued a successful "catch-up" policy for a few decades. Its energy consumption, especially fossil fuels, has skyrocketed with GDP, resulting in the largest CO2 emission globally. Figure 12 has a projection for China.

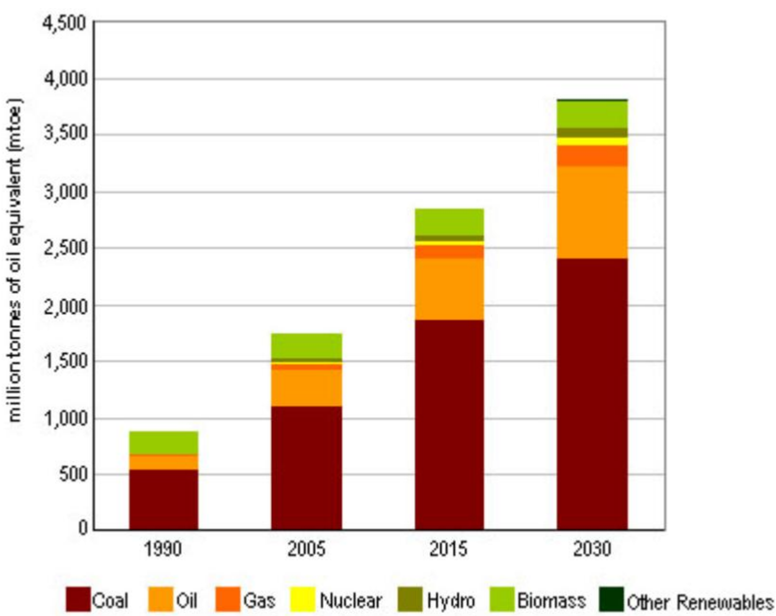


Figure 12. *Energy projection for China*
Source: [Retrieved from].

Decarbonisation does not seem highly probable. Much hope was placed at a recent reduction in CO2s, but water shortages forced China to revert to coal in 2017 with attending augmentation of CO2s. China is investing in both renewables and atomic power, but it also plans for large energy increase in the coming decades with lots of energy consuming new projects.

Resilience is not a promising option, as countries plan for much more supply of energy. Although each country needs to develop a decarbonisation strategy, involving the crucial steps in the necessarily giant energy transformation from fosil fuels to renewables, given the most recent information available about energy and its presuppositions, the COP21 secretariat could be helpful in designing the best projects and come up with cheap funding avenues, guaranteeing loans below market rates. It could make recommendation about carbon tax and renewable energy subsidies. Resilience is not a promising strategy against global externalities like the immense feedback lopes from global warming. It may end up in defection.

The new climate debate: "Already too late"

Among some climate scientists, there is recently a new urgency. The melting of the North polar ice is advancing so quickly that all projections about temperature rise on the Earth must be revised upwards. Quicker warming sets in motion very positive feedback s that threaten human survival. The goal of COP21 – limit global warming to + 2 degrees Celsius – is no longer achievable. Instead, climate chaos seems more likely. A few predict that mankind has no more than 10 years before things become unmanageable. When the North pole ice is gone, global warming goes much higher than + 2.

The theory that climate change is now becoming irreversible is based on new hypotheses concerning the consequences of global warming:

- sea level rise and Arctic ice meltdown is quicker than believed;
- climate refugees may rise to 100 million people;
- food and water shortages come earlier than believed;
- the + 2 degrees Celsius target is misplaced as the Earth warms differently at various regions, i.e. still much hotter at the poles;
- the release of methane from the permafrost and the frozen ice at the North pole will bring temperature rise to + 10 degrees Celsius;
- the COP21 policy is too slow and uncertain.

As the potentially huge methane emissions enter the climate change debate, one fully understands the mounting pessimism. And the entire time scale for fighting global warming shrinks considerably, from 100 years to 50 years or even less.

Yet, only improved COP21 policy-making could help. The Keeling must be stabilised as soon as possible, having reached 412 recently. The release of methane depends upon that. Thus, one may outline a more radical COP21 policy and ask for its implementation to start now:

1) Close down of all coal power plants in 2020; replacement of charcoal in poor countries by mini gas stoves;

2) Massive investments in solar power parks – see below; subsidies for solar installations in private homes;

3) Accelerated experiments with carbon capture to find accurate cost-benefit calculation.

Here comes the solar power revolution that will allow a massive reduction in fossil fuels. Let us see what it entails in terms of management tasks for global coordination, assisted by for instance the COP21 Secretariat and the IPCC.

Table 1. *Number of Ouarzazate plants for 40 per cent reduction of CO2 in some giant countries (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
United States	26-28	2100	3200
China	None	0	3300
EU28	41-42	2300	2300
India	None	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Australia	26-28	130	190
Russia	None	0	940
World	N/A	N/A	16000

Note: 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.

It will of course be argued against such a 40 per cent speedy reduction in CO2s that it leads to economic recession. So may it be! But it would reduce future much higher costs. After all, economies adapt and will recover due to all new investments needed in a decarbonised world. Ramesh (2015) emphasizes that India needs much economic assistance for decarbonisation – a giant task for global coordination to assist poor nations! Let us look at the American scene in Table 2.

Table 2. *Number of Ouarzazate plants necessary for 40 per cent reduction in CO2 (Note: Average of 250 - 300 days of sunshine per year was used for Canada, 300 – 350 for the others)*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Canada	30	230	300
Mexico	25	120	200

Argentina	None	0	80
Peru	None	0	15
Uruguay	None	0	3
Chile	35	25	30

Note: 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.

Some Latin American countries have lots of hydro power, but it may dwindle rapidly due to abrupt climate change. Solar power would be excellent energy for Mexico and Brazil for example.

Table 3 has the data for the African scene with a few key countries, poor or medium income. As they are not in general energy consuming on a grand scale, like Asia, decarbonisation should be feasible with Super Fund support.

Table 3. *Number of Ouarzazate plants necessary in 2030 for 40 per cent reduction in CO2 (Note: Average of 300 – 350 days of sunshine per year was used).*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Algeria	7-22	2100	3200
Egypt	None	0	3300
Senegal	5-21	2300	2300
Ivory Coast	28-36 iv	0	600
Ghana	15-45 iv	460	700
Angola	35-50 iv	180	170
Kenya	30 iv	120	170
Bostwana	17 iv	130	190
Zambia	25-47 iv	0	940
South Africa	None iv	N/A	16000

Note: 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.

Table 4 shows the number of huge solar parks necessary for a few Asian countries.

Table 4. *Number of Ouarzazate plants necessary for 40 per cent reduction in CO2s. (Note: Average of 250 - 300 days of sunshine was used for Kazakhstan, 300 - 350 days of sunshine per year for the others)*

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Saudi Arabia	None	0	150
Iran	4-12	22	220
Kazakhstan	None	0	100
Turkey	21	60	120
Thailand	20-25 iv	50	110
Malaysia	none iv	0	80
Pakistan	none iv	0	600
Bangladesh	3,45 iv	2	18

Note: 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.

Given the economic advances in Asia, most countries need a lot of solar power parks for decarbonisation. The COP21 management would be able to help.

Finally, we come to the European scene.

Table 5. *Number of Ouarzazate plants necessary for 40 per cent reduction in CO2s (Note: Average of 250 - 300 days of sunshine per year was used)*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Germany	49	550	450
France	37	210	220
Italy	35	230	270
Sweden	42	30	30

Note: 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 turn to renewables in Europe occur at the same time as atomic power stations are going to be closed, at least in some countries. Rational resilience? This makes solar power plants even more relevant, a coal power must be abolished, rather sooner than later. Other countries bet upon hydro power, but water is lost every year. Rational resilience? The US goes for natural gas, but fracking results in methane emissions. Rational resilience?

Conclusion

Time has come for halting and reducing CO2 emissions by real implementation and not Utopian dreams of a sustainable economy (Sachs, 2015). There is nothing to wait for any longer (Stern, 2015), as the COP23 must set up the promised Super Fund. No time for politicking in the UN any longer (Conca, 2015; Vogler, 2016). Time is tight with abrupt climate change.

It was hoped that the constant augmentation in CO2s would halt around 2015 and level off. But the new data for 2017 indicate that CO2s have started to increase again globally. This is very ominous, feeding global warming in the Arctic and the Antarctica. The culprit is as usual the rising energy consumption with heavy fossil fuel intensity – see Figure 13.

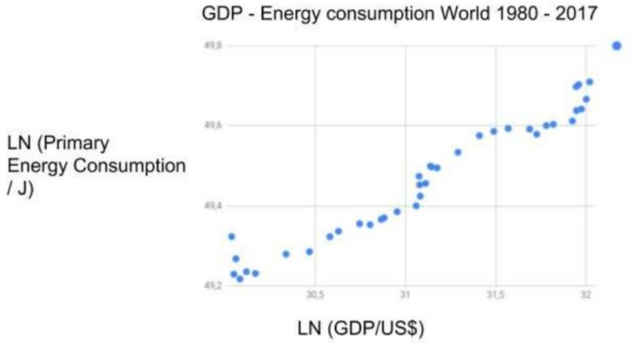

Figure 13. *GDP and energy globally*

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Ch.3. Is global management of anti-global warming policies at all feasible?

4 Abrupt climate change: Time is tight

Introduction

Climate and earth scientists have convinced a large majority of people that climate change occurs today. And the new theory of abrupt climate change entails that huge feedback lopes will change the Earth already within the next one or two decades. It is a matter of Arctic ice meltdown and methane emissions from the permafrost that may bring temperatures much higher than the COP21 Treaty aimed at with uncertain disastrous consequences for both Mother Earth and mankind. Lots of natural science research stil remains to be done in order to reduce the large uncertainties about temperature rise and its consequences for a number of vital outcomes for humanity.

Yet, this information is only half the story, as the pragmatical side is also part of climate change: will the COP21 promise of global decarbonisation be fulfilled? It requires global coordination by states or government, which is very hard to achieve. The COP process by the UNFCCC and the IPCC never speaks about it. The aim of this paper is to emphasize that global deecarbonisation can only be accomplished by global state coordination, which reduces the probability of COP21 success considerably.

Political economy of energy

Political economy is the social science interdisciplinary study of the interaction between markets and governments in determining poverty or affluence, democracy or dictatorship and war or peace. The political economy sources of global warming as driven by energy consumption of fossil fuels involves:

1) Market search for affluence and bypass climate change;
2) Government struggles against poverty and fear social upheaval.

Markets: Affluence, economic growth and enormous energy need

The market economy operates according to the logic of J.B. Say: supply determines demand. The firm aims to produce as much as possible at the lowest cost, making the enterprise profitable for its three interests – owners, managers and workers. Ideally, it is on a sustainable growth path over time, but it requires access to energy.

Energy shows up in every sector of the economy in a road sense, from transportation, industry, households and agriculture as well as electricity – see Figure with attending GHG emissions.

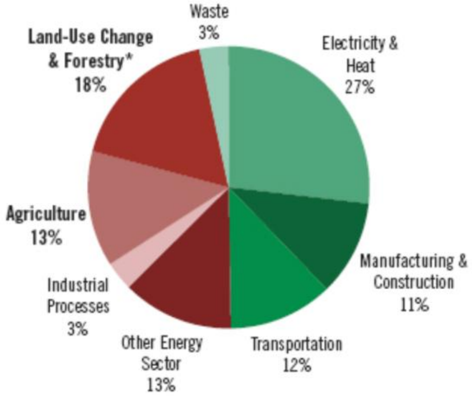

Figure 1. *Energy, sectors and GHGs globally*
Source: [Retrieved from].

In rich countries with an economy in balance more or less, domestically and internationally, the Say perspective upon economic motivations entails the idea of balanced economic growth, supported strongly by financial markets. Even if real economic growth fluctuates, the emphasis upon yearly economic growth is typical of capitalism or the market economy, but so far it has necessitated a constant augmentation of energy. Figure 2 shows the tight relation between affluence and energy.

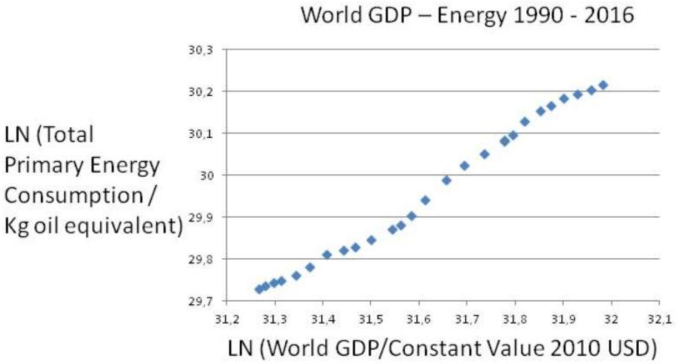

Figure 2. *Affuence and energy 1990-2016*

The market players would of course want this trend to just go on. But the attending CO2s call for major change (Figure 3) that markets may resist or underestimate or simply try to postpone. Figure 3 shows the global connection between energy consumption and CO2 emissions.

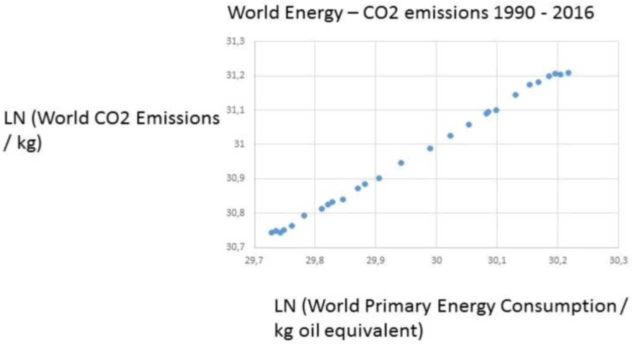

Figure 3. *Energy and CO2:s: y = 1,01x; R^2 = 0,99*
Source: BP Statistical Review of World Energy 2017, [Retrieved from]; Janssens-Maenhout *et al.*, 2017.

Markets have not yet fully anticipated the enormous costs of abrupt climate change. Production must be forthcoming that uses less energy and other energy resources, i.e. renewables. Business as usual make cover innovations like electrical cars, solar and wind energy and improved atomic power, but the size of fossil fuel energy remains much too large. Hating uncertainty, markets are in general favourable to the established energy plans.

The resistance of organised interests and financial institutions towards radical energy policies is understandable when one takes into account the market commitment to steady economic growth. The fear is depression – too little of Say's production with unemployment and falling demand. Some political parties in advanced democracies are very sensitive to economic decline not hesitation to favour fossil fuel energy extraction.

Government: Fear of massive instability, poverty and energy lack

Most people in the world live in the so-called Third World where poverty and social unrest results in political instability. Politicians know that the must deliver on promises to improve living conditions or face elimination somehow. Access to cheap energy is vital, meaning fosil fuels, especially coal and charcoal. 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.

African countries are poor because they have too little energy. Thus, they have much less GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydro power depends upon water availability that shrinks with global warming. African energy deficit is conducive to a dire environment with enormous damages and risks. Consider the following global figures. Figure 4 shows how low energy leads to am unsafe environmental.

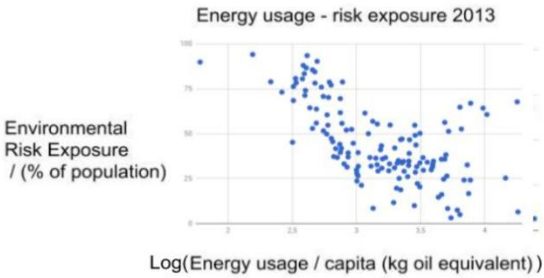

Figure 4. *Energy and environmental risk exposure*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 5 has the global picture.

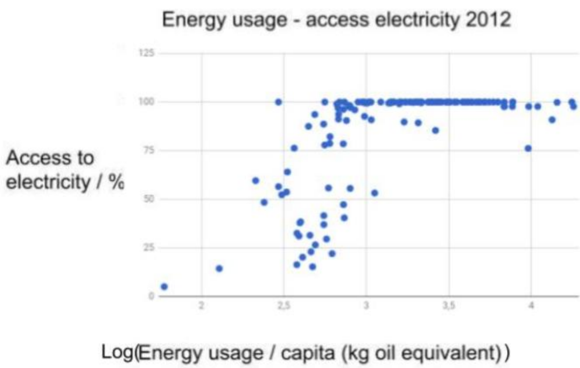

Figure 5. *Energy and electricity access*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 6 links energy with proper sanitation.

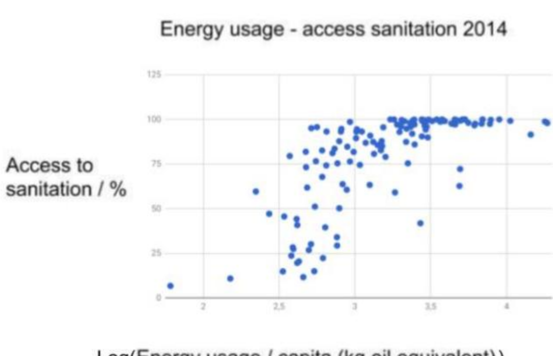

Figure 6. *Sanitation and energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 7 links energy with proper sanitation.

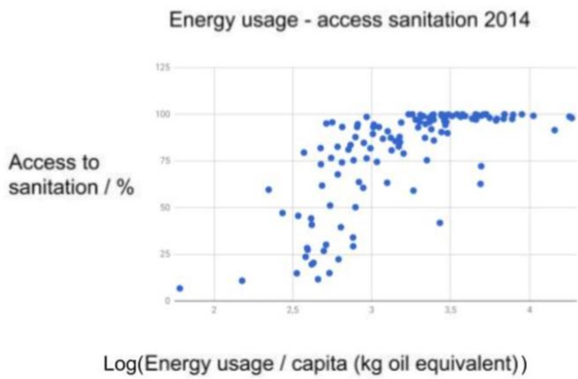

Figure 7. *Sanitation and energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Figure 8 underscores the necessity of more energy in poor coutries.

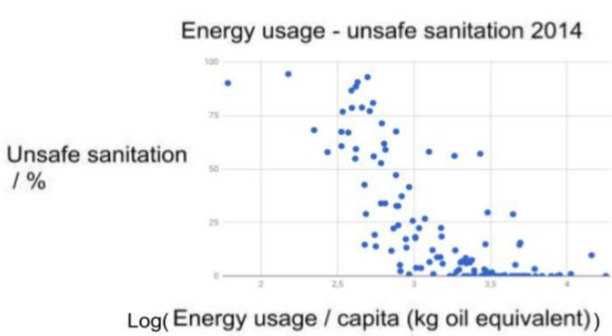

Figure 8. *Energy and unsafe sanitation*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Air quality too depends upon energy access (Figure 9).

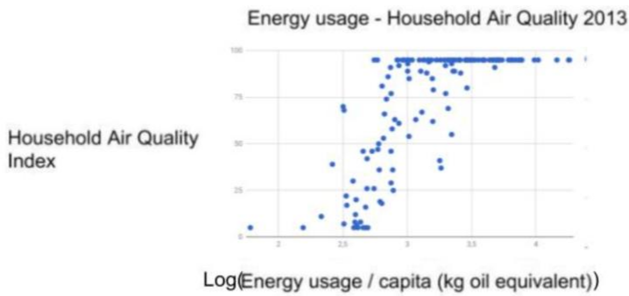

Figure 9. *Energy and air quality*

Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Typical of many 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!

Governments in the third world would line to have an assurance that the global COP21 project of decarbonisation does not lead to less energy or more expensive energy for them. Otherwise, governments may face social upheaval.

Abpurt climate change: Upgrade COP21

The UNFCCC and the IPCC have been surprised by the force of abrupt climate change. Its chief objective of limiting global warming to +2 degrees Celsius is hardly relevant any longer. Thus, its policies are also out of date namely:

a) stop the increase in CO2s by 2020;

b) reduce CO2s by some 30% by 2030 (absolutely of relatively?);

c) full decarbonisation by 2075.

Abrupt climate change alters the Keeling curve by projecting quicker temperature increases due to two dismal feedback lopes. First, we have the Arctic meltdown that will for a jump in temperature. Second, thee is the melting Permafrost with all its methane, conducive to climate chaos. No knows really how the objective + 2 degrees Celsius was arrived upon in COP21, but with abrupt climate change temperatures will likely go pass this limit already in 10-20 years.

To reduce the impact of positive feedback loops, the COP21 must sharpen its policy tools, reducing the CO2s quicker. If climate change accelerates as with abrupt global warming and its dismal feedback, the global coordination by the UNFCCC and IPCC should also change speed. The COP21 project should be implemented with more strength and efficiency.

1) Close down all coal everywhere and charcoal in poor countries (deforestation);

2) Start building giant solar power parks everywhere;

3) Find out if geo-engineering works on a large scale, like e.g. carbon capture.

There measures will NOT aggravate the situation, but only help, at least to some extent. Why then is global coordination so slow? The solar power revolution allows a massive reduction in fossil fuels. Let us see in Table 1 what it entails in terms of management tasks for global coordination, assisted by for instance the COP21 Secretariat and the IPCC.

Table 1. *Number of Ouarzazate plants for 40 per cent reduction of CO2 in some giant countries (Note: Average of 250 - 300 days of sunshine used for all entries except Australia, Indonesia, and Mexico, where 300 - 350 was used).*

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Senegal	5-21	2300	2300
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Ghana	15-45[iv]	460	700
Angola	35-50[iv]	180	170
Kenya	30[iv]	120	170
Bostwana	17[iv]	130	190
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Given the economic advances in Asia, most countries need a lot of solar power parks for decarbonisation. The COP21 management would be able to help. Finally, we come to the European scene.

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Carbon capture and geo-engineering

Many scientists put their hope with carbon capture or carbon sequestration. There are various methods but they all aim at eliminating CO2s by hiding them under ground, either ex ante production or ex post production. Experiments on a small scale indicate it can be done, but costs are high. Whether it can be done on a massive scale is uncertain. The basic problem is to make sure CO2s stay put in the Earth's crest. If it is released again into the atmosphere, all is in vain.

Several proposals of geo-engineering have been launched in order to cool the Earth somehow using aerosols being one example. However, the side effects of geo-engineering techniques are not fully known, which poses tremendous risks for mankind More research on geo-engineering is vital and urgent. Can the COP21 secretariat and IPCC coordinate and assist various efforts at country geo-engineering?

Reducing CO2s for ever by solar power parks appear easier than carbon capture or geoenginering, but both types of policies can be helpful together.

Country planning: Elimination of coal and charcoal?

The quickest and most effective way to jump start global decarbonisation is to simply take our all coal power stations and all charcoal use out. It would send the most powerful signal that the decarbonistion era has begun. Countries would find alternative energy resources in a short time, especially if aided by the COP21 project. Some countries may turn to natural gas and others to renewables!

Now, what would a total coal ban mean for the giant polluters of CO2? Can they handle than in a time of abrupt climate change? There is no "WE" in climate policy-making, because all plicies must be decided by te governments of the states of the world, using unanimity in global coordination boards like the UNFCCC or G20. Thre is always the exit option – defection. Each governments decision the basis of its energy situation which varies much from country to county. Understanding global warming, one must look at the energy predicament of each nation.

India

In Indian energy policies, it is emphasized that developmental goals take precedence over climate change considerations. Thus, all Indian household must have access to electricity and only sustained rapid economic growth can reduce poverty. India has a “take-off” economy that delivers affluence for the first time since independence. But it is based on fosil fuels. India looks into other sources of energy, as long as socio-economic development is not hindered. Figure 8 shows the main features of future planning.

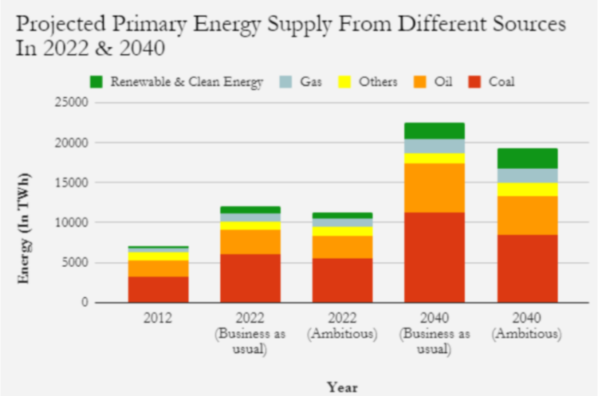


Figure 8. *India`s energy future*
Source: [Retrieved from].

India has rapidly become a major CO2 emitter due to its high growth rates since 1990. It uses lots of coal, stone or wood. Charcoal is bad for households and results in forest destruction. India tries to broaden its energy supply to modern renewables, like solar, wind and hydro power. Yet, it will remain stuck with fossil fuels for decades. It needs assistance from the COP21 project, especially for solar power parks. Building more dams is very risky, as global warming reduces water assets. Figure X indicates the India cannot meet its COP21 promises.

Brazil

Brazil is a "catch-up" with its "take-off" point long ago in the 20th century.. Compared with India, but it never really succeeds to close the gap to North America, tumbling now and then into dictatorship or recession. Figure Y shows its stylised energy plans – are they in agreement with COP21 hopes of decarbonisaton?

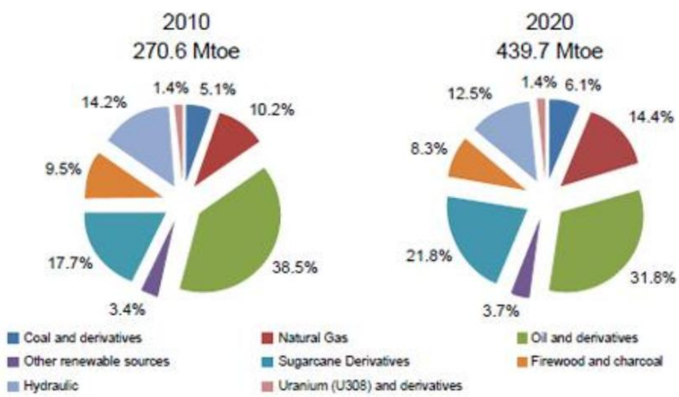
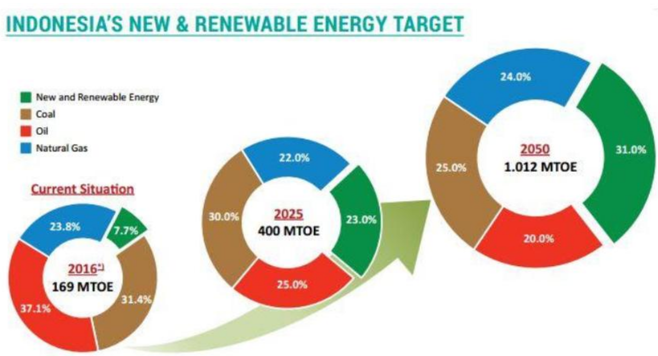


Figure 9. *Energy plans in Brazil*
Source: [Retrieved from].

Brazil has already a diversified supply of energy. However, since the country plans to almost double its energy supply, its dependence upon fossil fuel will grow, also upon coal. It dreams about building many more dams in the Amazons, but future water shortages due to climate change may make these plans unrealistic. The country needs COP21 assistance to turn to solar power massively, in order to eliminate first and foremost coal and charcoal. The rain forest is part of Brazil' s emission picture where burning and logging reduce its carbon uptake.

Indonesia

Indonesia is like India a "take-off" country, enjoying rapid economic growth with attending augmentation in energy consumption. The outcome is that this giant nation has quickly become a major GHG emitter. What make the situation worse is the burning down of the rain forest in parts of Indonesia.



	2016	2025	2050
NRE Mix	7.7 %	23%	31%
Energy Supply	169 MTOE	400 MTOE	1.012 MTOE
Generation Capacity	59 GW (NRE 8 GW)	136 GW (NRE > 45 GW)	443 GW (NRE > 167 GW)
Electricity/Capita	956 kWh	2.500 kWh	7.000 kWh
Electrification Rate	91%	~100%	~100%

Figure 10. *Energy future for Indonesia*

Indonesia`s energy augmentation plan is way beyond global decarnnisation plans.

USA

The US has reduced its CO2 emissions during the lats years, mainly by a shift to natural gas. Actually, several mature economies have been able to halt the rise of CO2 emissions, either by more energy efficiency or a shift to natural gas or renewables. Figure 11 captures some features in US energy plans.

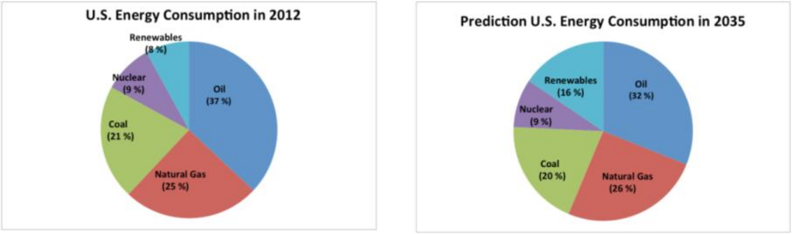


Figure 11. *US energy future*
Source: [Retrieved from].

Although the Figure 12 predicts a doubling of renewable energy, the dependency upon fossil fuels, including coal energy, will not bee much reduced. We are talking here about relative numbers, but if the US increases total amount of energy supply, then there may even be more fossil fuels. The reduction in CO2s during recent years seems to be coming at a reduced rate. The hope is for economic growth without energy increases, but we are not there yet. And most countries demand more energy for the future.

China

China now enters the First World, as it has long passed its "take-off" point in time around 1980 and has pursued a successful "catch-up" policy for a few decades. Its energy consumption, especially fossil fuels, has skyrocketed with GDP, resulting in the largest CO2 emission globally. Figure 12 has a projection for China.

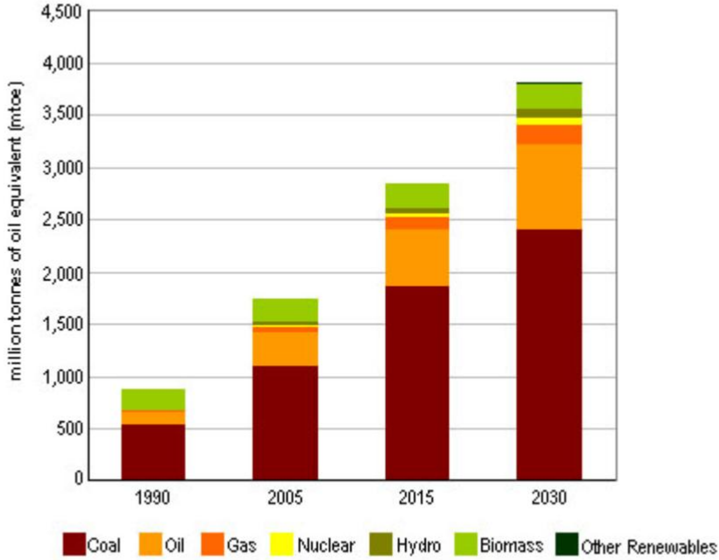


Figure 12. *Energy projection for China*
Source: [Retrieved from].

Decarbonisation does not seem highly probable. Much hope was placed at a recent reduction in CO2s, but water shortages forced China to revert to coal in 2017 with attending augmentation of CO2s. China is investing in both renewables and atomic power, but it also plans for large energy increase in the coming decades with lots of energy consuming new projects.

Conclusion

If climate change accelerates, as with abrupt global warming and its dismal feedback lopes, the global coordination by the UNFCCC and IPCC should also change speed. The COP21 project should be implemented with more strength and efficiency, for instance targeting the quick elimination of coal and the building of huge solar power parks in both First World and Thirld Wolrd countries. In poor countrues, before desertification often comes deforestation. It is often stated that land hunger drives deforestation. But equally relevant is the *search for energy*. We quote from a study on charcoal and deforestation in Africa.

Forests in Zambia are important in supporting life especially in low-income communities both in urban and rural areas. A variety of wood and non-wood forest products are utilised by industries, rural households and urban households in various parts of the country. However, today the forests in the country have been made vulnerable to both man and natural induced disasters. The rate at which forest cover is being lost has increasingly become high such that if this trend is left unchecked time may trigger the complete loss of biodiversity embodied in the Zambian forests. Perhaps the highest loss of forest cover was from 1990 to 2000 with a significant decline of 851,000 ha forest loss per year (FAO 2001). Deforestation as a result of land use change towards agriculture, illegal settlements and Current unsustainable levels of utilisation to mention but a few have contributed to the loss of forest cover in Zambia and the Southern Africa as a whole. The critical question seeking urgent redress is why forests in Zambia are being destroyed more and more. [Retrieved from].

The same findings apply to e.g. Kenya, Sudan and Ethiopia, but also to South Asia. Time for major energy transformation to save humanity from Hawking inrreversibility is much smaller than earlier believed (Stern, 2007, 2015).

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5 Why Africa needs the COP project badly

Introduction

In the climate change process, the African countries suffer badly from the biggest externality in human history (Stern, 2007, 2015). They are not among the big emitters of greenhouse gases or CO2: s. But they have to adapt their societies and economies to temperature rise that will most probably go over + 2 degrees, and maybe even + 3 degrees. How to cope? If temperature raises goes even further towards + 4-6 degrees, life will be threatened. How can people work under too hot circumstances? Water? The wildlife?

Yet, African governments have promised to contribute towards the COP21 objectives of decarbonisation by transforming their energy systems. How to pay? Even if African nations carry out their responsibilities under the UN Treaty, there is no guarantee that the big emitters of CO2:s will not renege. And then we have the danger of the new methane emissions.

There is a basic catch-22: The African continent uses less energy per capita than the other global continents, which entails that total emissions of CO2s are lower than in Asia, America and Europe. Yet, Africa badly needs more energy, as it is the capacity to do work that result in income and wealth (Sachs, 2015). If Africa could increase its energy share globally, it could reduce poverty and first and foremost secure its water supplies.

Energy on the continent

The countries on the African continent do not belong to the great polluters of CO2s in the world. Only a few of them have large CO2s like Egypt, Algeria, South Africa and Nigeria, but they do not rank among the really large 29 polluters in the world. This basic fact reflects their level of affluence, as energy and GDP are closely related. Consider Figure 1 with the global energy scene.

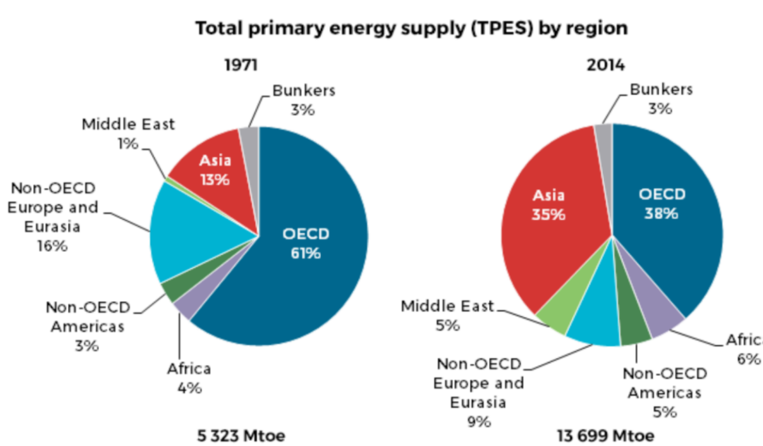

Figure 1. *Global energy*
Source: [Retrieved from].

It is small wonder that the African continent is the poorest, given its low share of global energy consumption. The population of Africa is increasing fast, meaning that much more energy is needed for economic and social development, but the COP21 decarbonisation Project must be respected!

African countries are unique in the sense that they do not contribute much to climate change, but they could stand to suffer enormously from global warming – the external effects of climate change. They range from excessive heat, constant need of air-conditioning (also augmenting emissions), droughts, ocean acidification, food shortages, and insupportable working conditions for peasants, etc. Yet, African governments can argue that they need much support for energy transformation, given the low share of global emissions for the continent – see Figure 2.

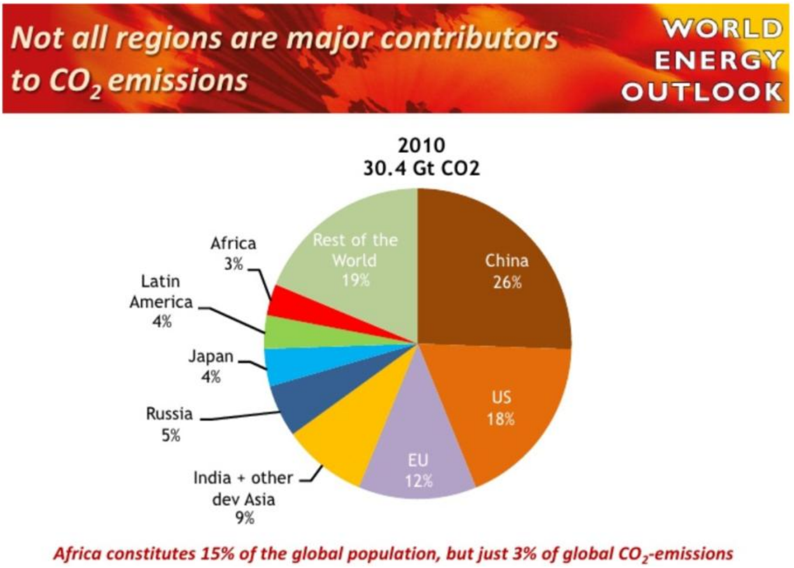

Figure 2. *Global emissions of CO2*
Source: [Retrieved from].

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 – see global Figure 3; but as energy consumption augments, so do emissions of GHG:s or CO2:s (Appendix 1). How to fundamentally transform global energy consumption?

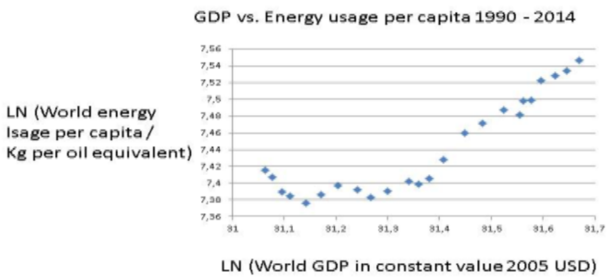

Figure 3. *GDP against energy per person (all countries)*

What is at stake for most people who understand the risks with climate change is not the *desirability* of decarbonisation in some form or another. They crux of the matter is *feasibility*: How to promote decarbonisation so that real life outcomes come about? The COP21 framework, and its three objectives, namely:

* Halting the increase in carbon emission up to 2020 (Goal I),

* Reducing CO2:s up until 2030 with 40 per cent (Goal II),

* Achieve more or less total decarbonisation until 2075 (Goal III),

will prove too demanding for most countries, I dare suggest - also for African nations in dire need of the promised Super Fund.

African governments must now start energy-emissions policy-making within the framework of the UN Convention on Climate Change. Positively, they can argue that energy consumption is far too low on the African continent. The population is rapidly growing and needs massive electricity supply. Simple global energy-emissions fairness requires this. Negatively, African nations are much dependent upon coal – wood coal except South Africa that uses stone coal – and oil and gas in the oil producing countries and Egypt. Most African countries employ wood coal and its derivatives, which maintain the continent in poverty. The COP21 project should be used by African governments for rapid electrification by means of NEW renewables, like e.g solar power.

The energy-emissions conundrum applies also to the African continent, as CO2:s is rising, driven by economic development. The situation in 1990 for 13 major African countries was as depicted in Figure 4.

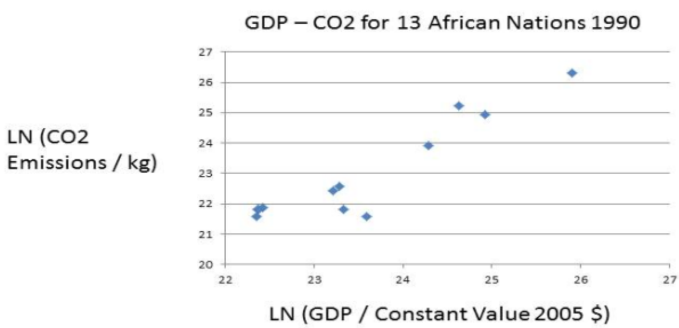

Figure 4. *GDP-CO2 link in 1990: y = 1,34x; R^2 = 0,87*

20 years later, emissions have increased following economic development. Surely, the UN would be interested in seeing CO2:s low in Africa, but then it must help with a fundamental energy transition from solids and fossil fuels to NEW renewables. (Figure 5).

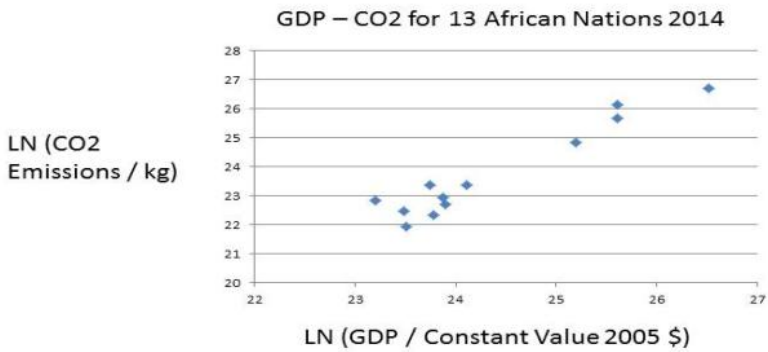

Figure 5. *GDP-CO2 link 2014: y = 1,47x; R^2 = 0,93*

Energy deficit consequences

African countries are poor because they have too little energy. Thus, they have much less GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydro power depends upon water availability that shrinks with global warming.

African 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 unsafe environmental.

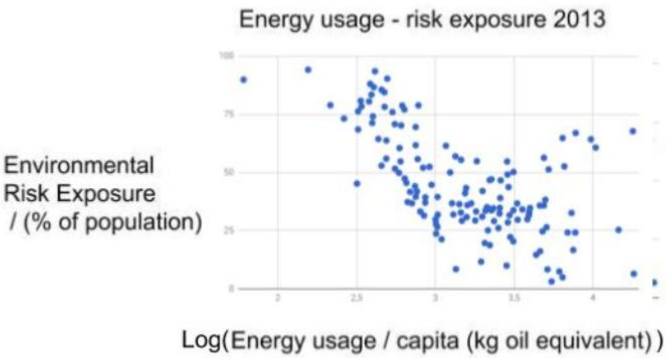

Figure 6. *Energy and environmental risk exposure*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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

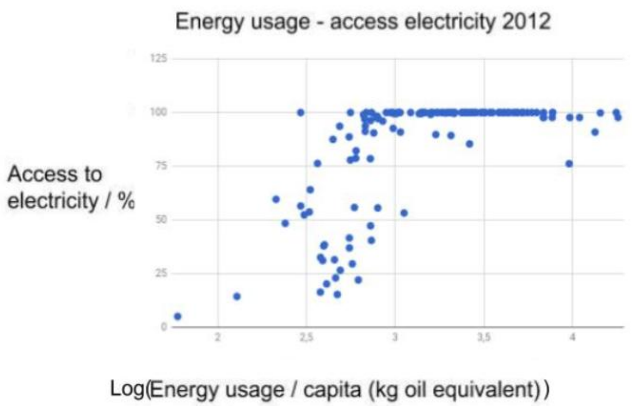

Figure 7. *Energy and electricity access*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

The access to safe and stable electricity is crucial for health, schools, food, water, etc.

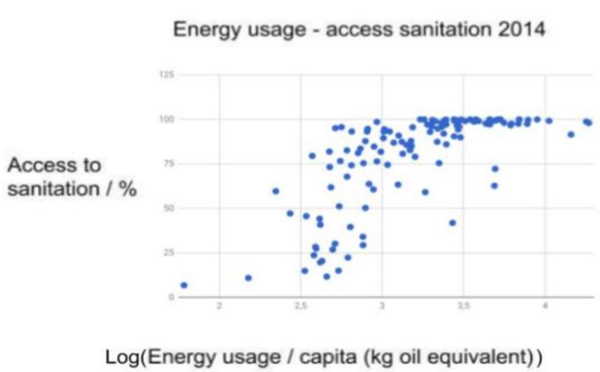

Figure 8. *Links of energy with proper sanitation*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Especially, the rapidly growing African mega-cities lack entirely sewage plants. Thus, dirty water is put into the big rivers or lakes where other cities downstream or close by take their potable water. Africa needs much more energy of a new kind.

Water problem in Africa

Environmental policy-making and implementation is inherently about politics, from its start to the finish, if it exists. Governments, national, regional and local have the responsibility for the environments and it may find partners – communities, civil society and business – in the policy cycle relating to ecology issues. Coordination failure is often occurring due to myopia, opportunism and conflicts between states or governments in a country. Environmental degradation is to be found for most lakes and rivers around the globe. But the extent of damage varies tremendously. What are often harmful for lakes and rivers are the construction dams for electricity generation.

The key question in relation to the degradation of lakes and rivers is: Will they shrink dramatically? Global warming and human exploitation work together to diminish lakes and rivers around the world, in several spectacular cases also on the African continent.

The most spectacular case of lake shrinking or disappearing today is Lake Chad in the centre of Sahara. It is now 1/5th of its size in 1970, when a public investigation and control mechanism was launched by the five neighbouring countries, to no avail. The lake is now only 7 meters deep and will disappear soon. The reason: human overuse for drinkable water and irrigation. Outcome: Population movements, or environmental refugees in politically instable countries. The River Nile is loosening water due to the construction of several dams in Ethiopia and Sudan. Egypt has expressed concern for its water supply in the near future, but there is no formal intergovernmental regulation of this water conflict. The mighty Nile will soon no longer be so powerful, as the water flow from both the White and Blue Nile diminishes due to dams as well as the Mediterranean Sea eats into its delta with inflowing salt water. Outcome: increased water scarcity in Egypt with food shortages; severe political conflict between Egypt, Ethiopia and Sudan; more electricity for Ethiopia and Sudan.

In Africa, one may also wish to mention the river Niger and the Lake Victoria, when speaking of ecological disasters in the future. Both are deteriorating, Niger River due to dams and Lake Victoria due to human exploitation and global warming.

The situation is hardly much better in other parts of Africa: lakes are under deterioration because of human activities on the one hand – overfishing, waste and sewage disposal, and take out of water for various purposes – as well as global warming on the other hand; rivers increasingly come under pressure from dam construction, sewage and waste, as well as water take outs. This negative evaluation holds for among others the large lakes of Lake Malawi and Lake Tanganyika as well as for great rivers like The Congo, The Chobe, the Zambezi, etc. The River Congo has to cope with logging in addition to human pollution. Thus, legal or illegal harvest of the rain forest in the huge Congo Basin opens up roads that may be used for further exploitation.

Given the predicament of rivers and lakes in Africa, one may predict a shortage of fresh, clean, drinkable water soon with negative repercussions for food.

Absence of modern energy sources

With the possible exception of the Quarzazate solar plant in Morocco, African countries relies mostly upon fossil fuels and traditional renewables like wood coal. Hydro power has become more important, but its sustainability may be doubted. Water resources are often shared between nations, causing tensions between states. Let us look at a few examples.

Coal

The RSA has a modern economy running on mainly coal (Figure 9). In transportation, it uses petroleum. This makes the RSA a major CO2 polluting nation. It wants to spread electricity to all shanti-towns, but with what energy source?

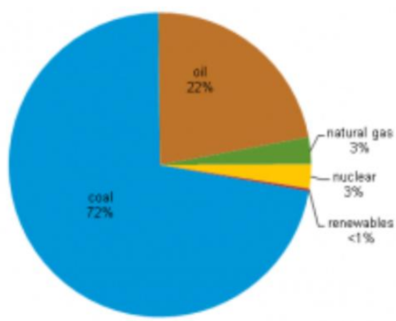

Figure 9. *Energy consumption in RSA*

Does the RSA have the resources and motivation to cut the coal consumption radically and move to solar energy for instance? Or could the RSA renege on COP21 – the always available option in collective action endeavours?!

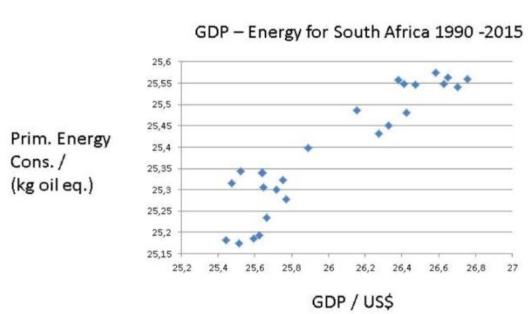

Figure 10. *Shows the necessity of more energy for raising livings standards*

The promises made to the deprived population includes lots of energy demanding projects in health, housing, schooling, etc. Only a massive investment in solar power parks can deliver this, requiring support from the Super Fund in the COP effots.

Oil

Some African countries produce lots of oil and consume some of it themselves. One country almost only relies upon oil and gas.

Algeria

Algeria is a major exporter of natural gas and oil, Thus, we expect that it relies exclusively on fossil fuels, like Mexico, Iran and the Gulf States. Figure 11 verifies this expectation.

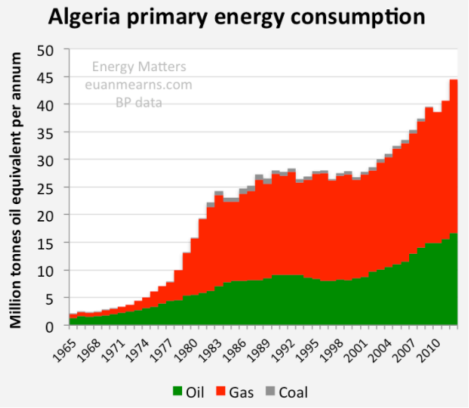

Figure 11. *Energy mix in Algeria*
Source: [Retrieved from].

Although Algeria may have great trust in the availability of future fossil fuels resources in the country, it still faces the demand for a 40% reduction of its CO2 emissions from the COP21. Emissions have thus far followed the economic progress very closely– see Figure 12.

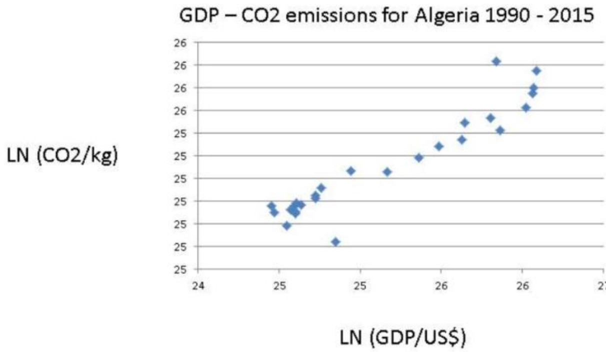

Figure 12. *Link GDP-CO2 in Algeria*

Algeria has much youth unemploymens an must care for its growing population. It needs a new energz source, namely solar power parks in Sahara.

Gas

Egypt has a huge population with high unemployment and mass poverty besides a high level of political instability, resulting from religious conflicts. But surely it has electricity from ins giant Assuam dam and the Nile? No, it does not count for much for Egypt, where most people live in the Nile delta. CO2:s are on a sharp upward trend for Egypt dur to energy demand rising quickly (Figure 13).

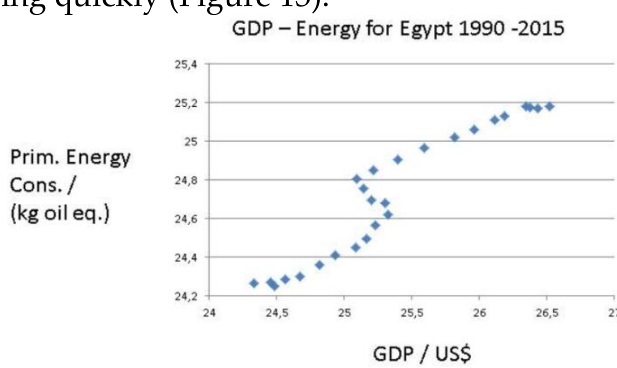

Figure 13. *Energy-GDP link for Egypt*

Egypt has an enormous growth in population. Its water resources are challenged by upstream countries. It builds a new capital, but CO2:s are rising sharply (Figure 14).

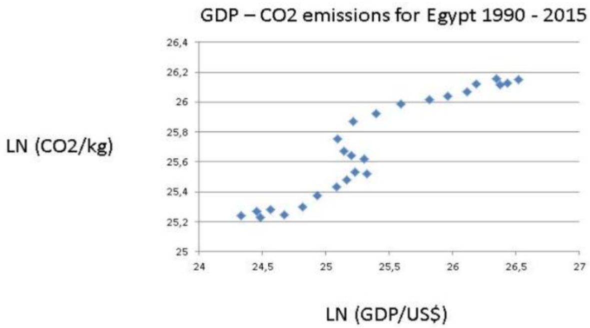

Figure 14. *GDP-CO2 for Egypt: $y = 1{,}02x$; $R^2 = 0{,}99$*

It will be very difficult for Egypt to make the COP21 transformation, at least without massive external support. But where to build huge solar power plants in a country with terrorism, threat or actual? The share of hydro power is stunning low for a country with one of largest rivers in the world. Actually, the water of the Nile is the source of interstate confrontation between Egypt, Sudan and Ethiopia, because the latter two have started to exploit it recently.

Wood Coal and Hydro Power

In the climate change discussions and policy-making, it is often stated that renewables should be preferred over non-renewables. Yet, this statement must be strictly modified, as there are two fundamentally different renewables:

* Traditional renewables: wood, charcoal and dung. They are not carbon neutral. On the contrary, employing these renewables results in severe pollution, not only outside but also inside household;

* New renewables: solar, wind, geo-thermal and wave energy that are indeed carbon neutral, at least at the stage of functioning.

In the poor African countries with about half the population in agriculture and small villages, traditional renewables constitute the major source of energy.

Kongo Kinshasa

One understands the hefty use of wood coal in this giant country, so plagued by political instability, anarchy, anomie and civil wars with foreign involvement (Figure 15).

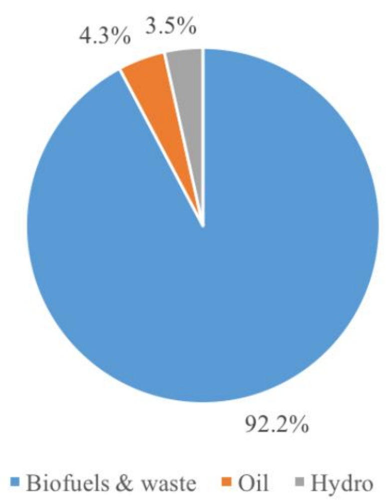

Figure 15. *Dr Kongo*

Source: Democratic Republic of Congo - Energy Outlook, Kungliga Tekniska Hoegskolan

One notes how little of hydro power has been turned into electricity in Kongo, but economic development and political instability, civil war and anarchy do not go together normally. At the same, one may argue that an extensive build-up of hydro power stations would pose a severe challenge to the fragile environment in the centre of Africa.

Kongo can now move directly to modern renewables like solar power.

Sudan

The energy consumption of Sudan reflects this situation – Figure 16. The countries relying upon traditional renewables to an extent up to 50 per cent or higher will have to reflect upon how to bring these figures down sharply with modern renewables. It is an entirely different task than that of countries with too much fosil fuel dependency. Hydro power has increased in Sudan, which is a positive. But the water of the Nile can last only so long for three large energy power hungry nations, with Egypt fearing for water shortages in agriculture and potable water.

Sudan is dismally poor with deep-seated internal conflicts ethnically. How to move to large solar panel plats in a country with so much political instability resulting huge numbers of death from domestic violence?

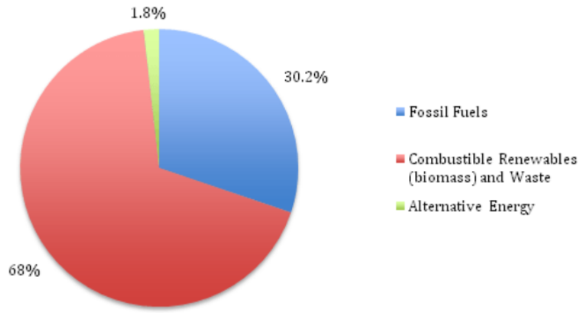

Figure 15. *Sudan's energy mix*
Source: [Retrieved from].

Ethiopia

The reliance upon traditional renewables is so high in neighbouring Ethiopia that electrification must be very difficult to accomplish over the large land area. Figure 16 displays a unique predicament, although a few hydro power stations have increased hydro power substantially since 2008.

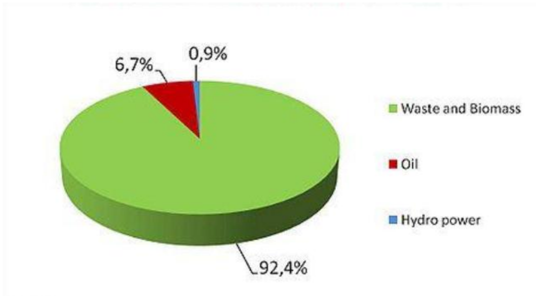

Figure 16. *Ethiopia: Energy mix*

Are there any advantages with such a skewed energy mix? No, because even mainly rural Ethiopia delivers with lots of CO2: - see Figure 17.

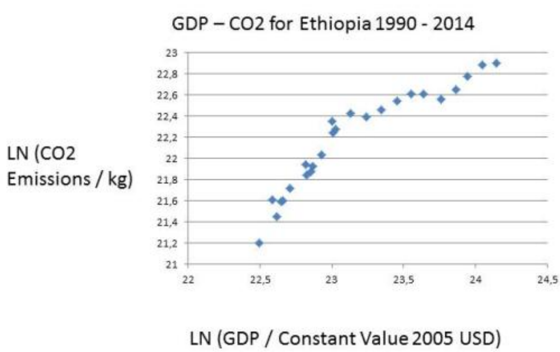

Figure 17. *Ethiopia: GDP and CO2: $y = 0{,}90x$, $R^2 = 0{,}88$*

The zest with which Ethiopia is pursuing its control over water resources becomes fully understandable. What we see is the same smooth linear function plotting CO2:s upon GDP, as is obvious in countries based upon fosil fuels – see below. For Ethiopia, to comply with COP21 goals is going to pose major challenges, especially if economic development is not going to be reduced. The country needs massive help, both financially and technologically.

The Grand Ethiopian Renaissance Dam in Ethiopia and the Merowe Dam in Sudan bring electricity to Africa. Hydro power could be much more exploited in several African countries, but time is running out. Global warming reduces rivers and enhances draughts. Solar power is the future for all nations, whatever pattern of energy consumption they now have.

Conclusion

Poverty and especially water shortage on the African continent reflects the energy situation. Yet, as African nations increase energy, they must at the same time reduce CO2: s. The COP project is a great opportunity for African peoples, but the promise of support must really be forthcoming. New energy must be directed to secure water resources, construct sewage plants, halt overfishing and safeguard access to potable water. The use of wood coal in connection with deforestation is very bad. A sustainable future for Africa (Sachs, 2015) is offered by massive investments in solar power, and time presses (Stern, 2007, 2015).

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OECD National Accounts data files

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6 Management of the Cop21 policies: What is lacking in the Cop21 project

Introduction

It is emphasized by the natural sciences that the increase in the greenhouse gases (GHG) in Earth' atmosphere is due to human causes, as the emission of GHGs from nature has remained stable since the start of the industrial revolution. Several kinds of GHGs exist, but the UNFCCC has concentrated upon the CO2s in their coordination efforts to halt GHG increases in the COP21 project. Other GHGs like for instance methane and NO2 are more potent in their greenhouse effect, but occur in less quantity today.

Can the increase in GHGs be stopped before the so-called Hawking irreversible point, where climate chaos becomes unstoppable? To ponder about the question, so fatal for humanity, we need a theory about the increase in GHGs. Why do they continue to increase? Global government coordination has come so far that the UN has enacted the policy objective of almost complete decarburization in this century at the COP21 reunion in Paris 2015. Bur how is this formidable objective to be managed?

Thus far, the COP21 project involves a halt to the increase in CO2 emissions by 2020, a 30% reduction in CO2s by 2030 (absolutely or relatively?) and more or less total decarburization by 2075. But the means to these gigantic goals? It is all about managing energy transformation, as the augmentation of GHGs stems from human use of energy resources.

Policy and management: Climate or economic crisis?

As we get more and more dire predictions about the nature of climate change and its probable consequences, it becomes more and more urgent to clarify what the COP project can and must accomplish. Climate change could be halted by a sharp reduction in the use of fossil fuels over night, but it would spell large scale economic crisis with mass unemployment and social upheaval.

Many climate experts now claim that we are heading for more than a + 2 Celsius increase in global warming as well as already a + 2 Celsius augmentation is a threat to human survival due to the many positive feedback loops started by such an increase. As the doomsday scenarios gather strength, it becomes absolutely vital to stick to the COP project and explore what can be achieved and how.

The overall objective of the COP21 project from Paris 2015 is to start decarbonisation by 2020 and finish it by 2075. A necessary condition is that states conduct energy policies that eliminate coal and start solar power parks. This requires enormous management skills by individual governments with support from global coordination agencies or committees. A drastic policy tool is carbon sequestration or capture, but it is hardly viable at the moment. Climate engineering may add to the basic means: abolition of coal and big solar power parks.

Let us explore below whether the key countries are moving or planning to move in this decarbonisation direction? Each single country has its energy consumption pattern that must be taken into account in both domestic and international energy supply transformation.

Energy in a wide sense

I suggest we analyze energy in a wide sense. The need for energy is obvious in all the human sources of GHGs – see Figure 1.

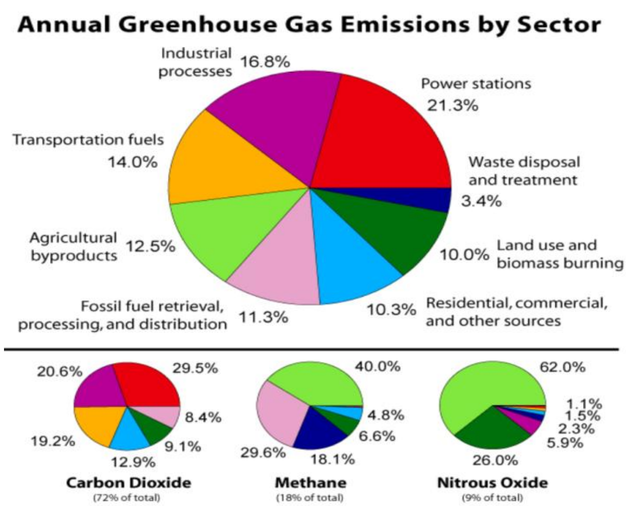


Figure 1. *Human sources of GHGs, globally*
Source: [Retrieved from].

What Figure 1 shows is that the GHGs stem from all vital sectors of society, not merely energy production itself. Energy is the capacity to do work. And work is the source of human welfare. The growth in energy consumption since the industrial revolution and especially after the Second World War has been just immense, especially the supply of fossil fuels. In poor countries, the demand for energy is huge for economic development, whereas rich countries are heavily dependent of fossil fuels for economic growth.

Poor countries

The majority of countries in the COP project are in poverty, as they need more energy. Thus, they can only decarbonise when renewable energy sources become available. This is the redistribution task of C0P21.

Energy and living conditions

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.

African countries are poor because they have too little energy. Thus, they have much less GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydro power depends upon water availability that shrinks with global warming.

African energy deficit is conducive to a dire environment with enormous damages and risks. Consider the following global figures. Figure 2 shows how low energy leads to am unsafe environmental.

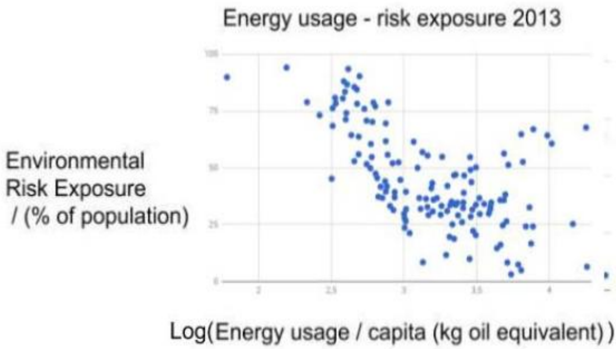


Figure 2. *Energy and environmental risk exposure*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 3 has the global picture.

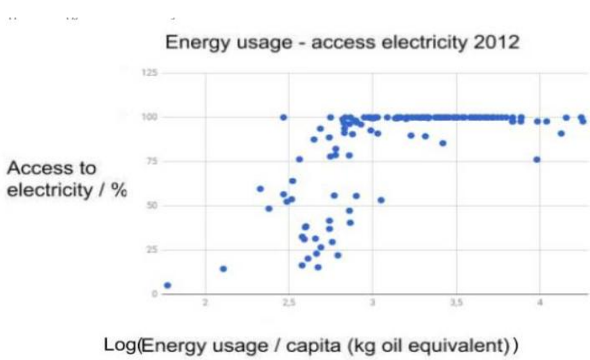


Figure 3. *Energy and electricity access*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 4 links energy with proper sanitation.

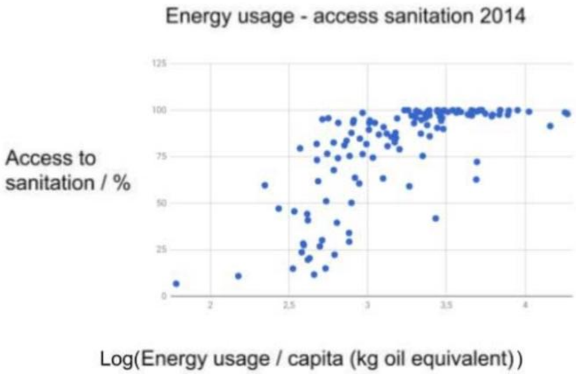


Figure 4. *Sanitation and energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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. Figure 5 links energy with proper sanitation.

The access to safe and stable electricity is crucial for health, schools, food, water, etc.

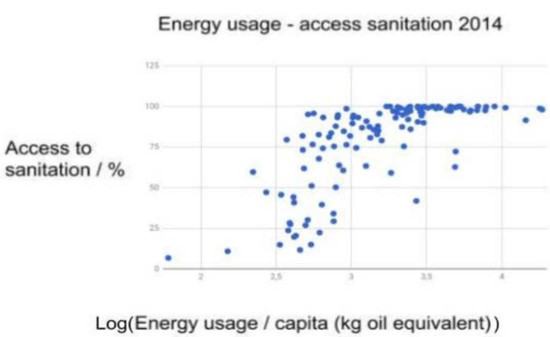


Figure 5. *Sanitation and energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Figure 6 underscores the necessity of more energy in poor coutries.

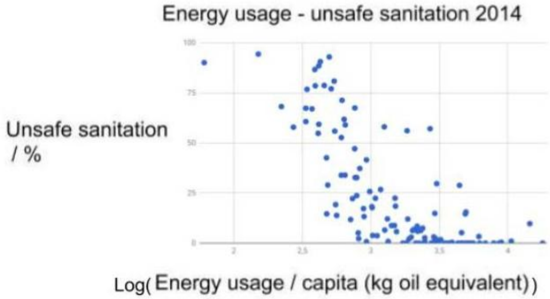


Figure 6. *Energy and unsafe sanitation*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Air quality too depends upon energy access (Figure 7).

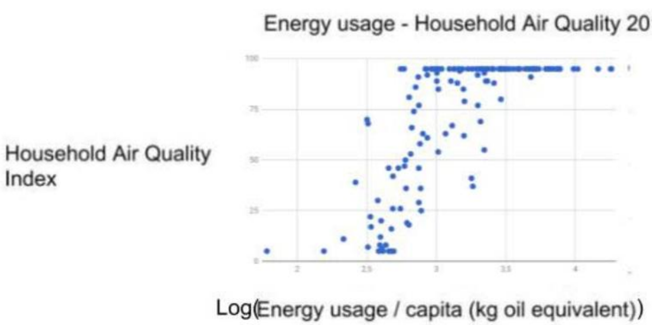


Figure 7. *Energy and air quality*

Typical of many 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 beter access to just energy!

To Sum Up: If, as we believe, energy consumption is behind global warming, the set of poor countries face a most difficult dilemma. On the one hand, they can demand much more energy like fossil fuels, but they then contribute much to climate change, On the other hand, global warming while fabricated by the rich nations and a few very populous poor nations, will have very negative consequences for poor nations. The only way out of this dilemma is that all countries contribute to halting global warming by turning to renewables, especially the set of rich countries.

Energy demand

Energy consumption is closely related to country affluence. The poor countries can only improve living condition by increase energy supply. Their energy demand can only go up, because energy supply is highly skewed to the advantage of the rich countries – see Fig 7.

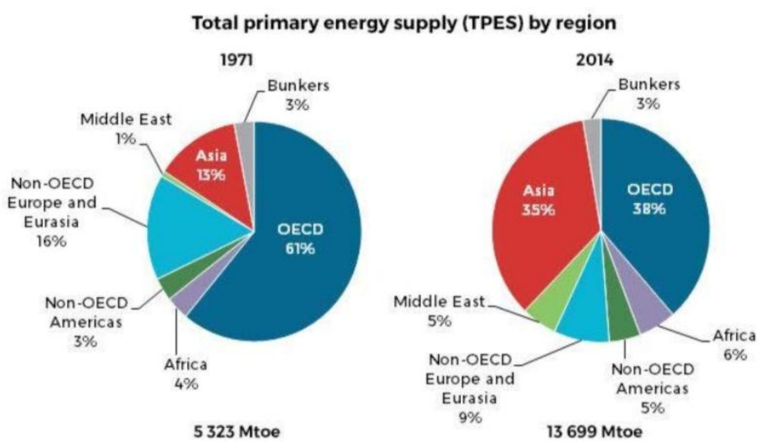


Figure 7. *Global Energy Consumption*
Source: [Retrieved from].

Poor countries need much more energy, but of a new kind. They need assistance to move to modern renewables, as they will give up fossil fuel only if there is compensation by other new energy sources. Let us take three examples. It must be underlined that GHG emissions are a function of GDP and population. Only very big poor countries have huge GHG emissions, like India, Brazil and Indonesia. Small poor nations have little GHGs, as they lack energy in great quantity. Yet, poor countries wish to participate in saving the planet from the dangers of climate change on the condition of financial assistance from the COP project and its Super Fund.

India

In Indian energy policies, it is emphasized that developmental goals take precedence over climate change considerations. Thus, all Indian household must have access to electricity and only sustained rapid economic growth can reduce poverty. India has a "take-off" economy that delivers affluence for the first time since independence. But it is based on fosil fuels. India looks into other sources of energy, as long as socio-economic development is not hindered. Figure 8 shows the main features of future planning.

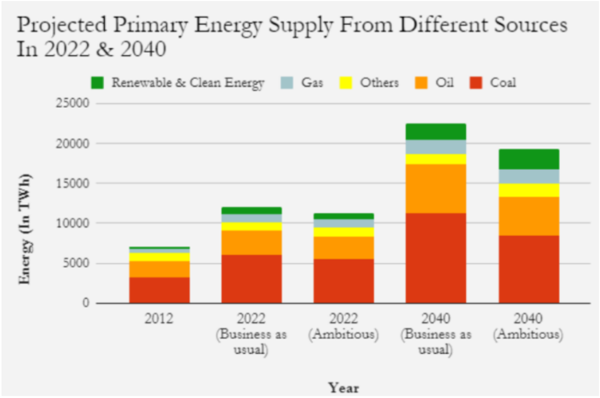


Figure 8. *India`s energy future*
Source: [Retrieved from].

India has rapidly become a major CO2 emitter due to its high growth rates since 1990. It uses lots of coal, stone or wood. Charcoal is bad for households and results in forest destruction. India tries to broaden its energy supply to modern renewables, like solar, wind and hydro power. Yet, it will remain stuck with fossil fuels for decades. It needs assistance from the COP21 project, especially for solar power parks. Building more dams is very risky, as global warming reduces water assets. Figure X indicates the India cannot meet its COP21 promises.

Brazil

Brazil is a “catch-up” with its “take-off” point long ago in the 20th century.. Compared with India, but it never really succeeds to close the gap to North America, tumbling now and then into dictatorship or recession. Figure Y shows its stylised energy plans – are they in agreement with COP21 hopes of decarbonisaton?

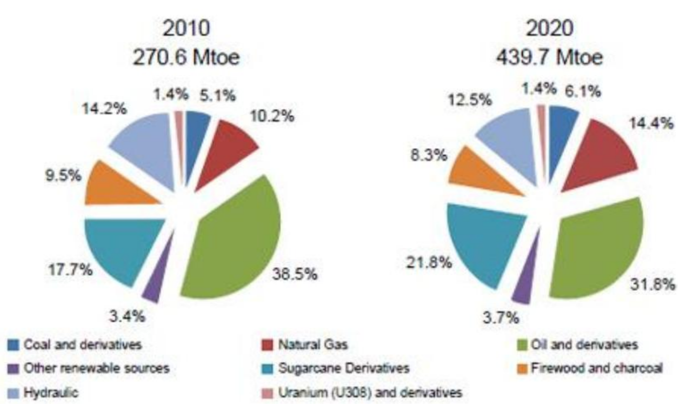
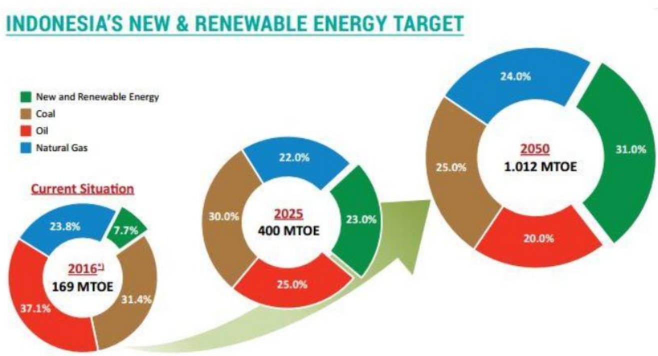


Figure 9. *Energy plans in Brazil*
Source: [Retrieved from].

Brazil has already a diversified supply of energy. However, since the country plans to almost double its energy supply, its dependence upon fossil fuel will grow, also upon coal. It dreams about building many more dams in the Amazons, but future water shortages due to climate change may make these plans unrealistic. The country needs COP21 assistance to turn to solar power massively, in order to eliminate first and foremost coal and charcoal. The rain forest is part of Brazil' s emission picture where burning and logging reduce its carbon uptake.

Indonesia

Indonesia is like India a "take-off" country, enjoying rapid economic growth with attending augmentation in energy consumption. The outcome is that this giant nation has quickly become a major GHG emitter. What make the situation worse is the burning down of the rain forest in parts of Indonesia.



	2016	2025	2050
NRE Mix	7.7 %	23%	31%
Energy Supply	169 MTOE	400 MTOE	1.012 MTOE
Generation Capacity	59 GW (NRE 8 GW)	136 GW (NRE > 45 GW)	443 GW (NRE > 167 GW)
Electricity/Capita	956 kWh	2.500 kWh	7.000 kWh
Electrification Rate	91%	~100%	~100%

Figure 10. *Energy future for Indonesia*

Indonesia`s energy augmentation plan is way beyond global decarnnisation plans.

Rich Countries

In terms of GHGs, rich countries have much higher levels of yearly emissions compared with poor countries, holding population constant. Only when a poor. Strict linear relations hold between GDP, energy consumption and

GHGs, both on a per capita basis and on an aggregate country level. I will only show one Figure to show this – Figure 11.

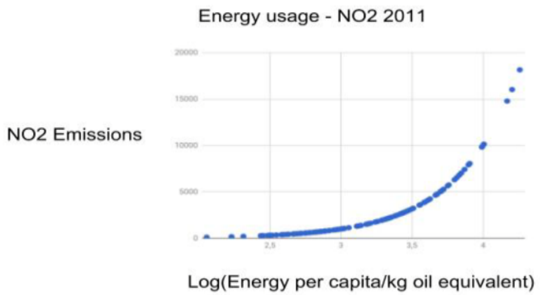


Figure 11. *Nitrous oxide and rich countries*

While the UNFCCC has mainly concentrated upon the CO2s, the GHGs comprise several gases, on of which is the nitrogen oxide. Production of nitrous oxide stems from microbial activity in soils and in the ocean. Human sources of nitrous oxide are combustion of fossil fuels, biomass burning, industrial production of nitric acid, and fertilizers. Nitrous oxide enhances the greenhouse effect just as carbon dioxide does by capturing reradiated infrared radiation from the Earth's surface and subsequently warming the troposphere. It stays in the troposphere for about 120 years before moving into the stratosphere where it is conducive to the destruction of stratospheric ozone.

Mature economies

The US has reduced its CO2 emissions during the last years, mainly by a shift to natural gas. Actually, several mature economies have been able to halt the rise of CO2 emissions, either by more energy efficiency or a shift to natural gas or renewable. Figure 12 captures some features in US energy plans

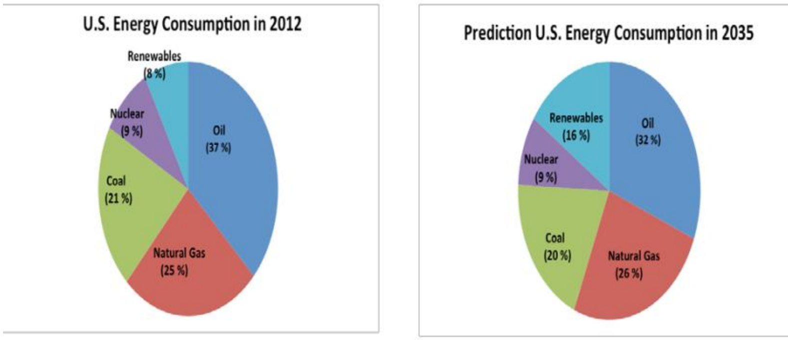


Figure 12. *US energy future*
Source: [Retrieved from].

Although the Figure 12 predicts a doubling of renewable energy, the dependency upon fosil fuels, including coal energy, will not bee much reduced. We are talking here about relative numbers, but if the US increases total amount of energy supply, then there may even be more fosil fuels. The reduction in CO2s during recent years seems to be coming at a reduced rate. The hope is for economic growth without energy increases, but we are not there yet. And most countries demand more energy for the future.

Emerging economies

China now enters the First World, as it has long passed its "take-off" point in time around 1980 and has pursued a successful "catch-up" policy for a few decades. Its energy consumption, especially fossil fuels, has skyrocketed with GDP, resulting in the largest CO2 emission globally. Figure 13 has a projection for China.

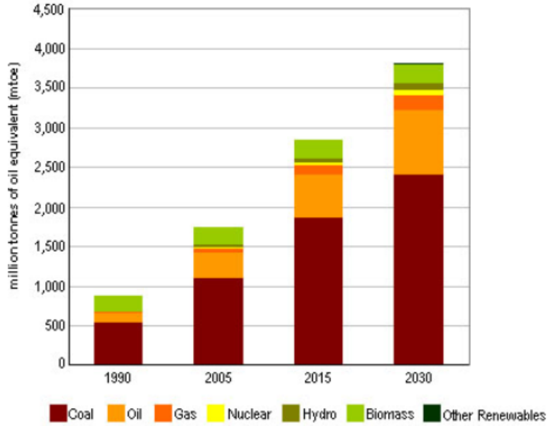


Figure 13. *Energy projection for China*
Source: [Retrieved from].

Decarbonisation does not seem highly probable. Much hope was placed at a recent reduction in CO2s, but water shortages forced China to revert to coal in 2017 with attending augmentation of CO2s. China is investing in both renewables and atomic power, but it also plans for large energy increase in the coming decades with lots of energy consuming new projects.

Policy implementation entails management

Now, climate experts talk about the "methane bomb", widening the set of GHGs to focus upon methane, emerging chaotically from the melting permafrost in the Northern most part of the hemisphere or from melting ice containing frozen methane at the seabed in the Arctic. The potential amount of methane to be released in worst case scenario is so large that global warming would quickly move beyond the Hawking irreversible point, spelling doom for mankind. The time spam for the methane bomb is uncertain, from 50-200 years. What to do? At this point in time, global coordination against climate change can only intensify its efforts at decarbonisation during the 21st century. The COP21 project has to be pursued and fulfilled in an improved version with quicker actions, complemented by other activities like carbon sequestration or geo-engineering, if workable. Hopefully, the US will reenter this common pool regime later.

Theory: The basic hypothesis is the strong link between CO2 emissions and global temperature – Keeling' curve. Only by halting CO2 emissions first and then start reducing them can global warming be stopped and the methane bomb avoided. This is the foundation of the COP21 project and the possibility of geo-engineering may be an option as time goes by.

Implementors: The COP21 secretariat comprises some 450 persons, planning new global reunions, and monitoring the development of the country engagement for the Treaty as well as negotiating the promised reductions in CO2s. It could be turned into a management agency assisting countries cut CO2s on the basis of interaction the Intergovernmental Panel for Climate Change (IPCC).

Management tasks: Each country needs to develop a decarbonisation strategy, involving the crucial steps in the necessarily giant energy transformation from fossil fuels to renewables, given the most recent information available about energy and its presuppositions. The COP21 secretariat could be helpful in designing the best projects and come up with cheap funding avenues, guaranteeing loans below market rates. It could make recommendation about carbon tax and renewable energy subsidies.

Competences: A reinforced COP21 developing into the management of global decarbonisation would act as an agency of first the UNFCCC and second as the agent of the principals of the UN, viz. the member states. Its tools of management would be persuasion, oversight, recommendations, negotiations, but not authority or interference

The new climate debate: "Already too late"

Among some climate scientists, there is recently a new urgency. The melting of the North polar ice is advancing so quickly that all projections about temperature rise on the Earth must be revised upwards. Quicker warming sets in motion very positive feedback s that threaten human survival. The goal of COP21 – limit global warming to + 2 degrees Celsius – is no longer achievable. Instead, climate chaos seems more likely. A few predict that mankind has no more than 10 years before things become unmanageable. When the North pole ice is gone, global warming goes much higher than + 2.

The theory that climate change is now becoming irreversible is based on new hypotheses concerning the consequences of global warming:

- Sea level rise and Arctic ice meltdown is quicker than believed;
- Climate refugees may rise to 100 million people;
- Food and water shortages come earlier than believed;
- The + 2 degrees Celsius target is misplaced as the Earth warms differently at various regions, i.e. still much hotter at the poles;
- The release of methane from the permafrost and the frozen ice at the North pole will bring temperature rise to + 10 degrees Celsius;
- The COP21 policy is too slow and uncertain.

Policy response to abrupt climate change

As the potentially huge methane emissions enter the climate change debate, one fully understands the mounting pessimism. And the entire time scale for fighting global warming shrnks considerably, from 100 years to 50 years or even less.

Yet, only improved COP21 policy-making could help. The Keeling must be stabilized as soon as possible, having reached 412 recently. The release of methane depends upon that. Thus, one may outline a more radical COP21 policy and ask for its implementation to start now:

1) Close down of all coal power plants in 2020; replacement of charcoal in poor countries by mini gas stoves;
2) Massive investments in solar power parks – see below; subsidies for solar installations in private homes;
3) Accelerated experiments with carbon capture to find accurate cost-benefit calculation. Here comes the solar power revolution that will allow a massive reduction in fossil fuels. Let us see what it entails in terms of management tasks for global coordination, assisted by for instance the COP21 Secretariat and the IPCC.

Table 1. *Number of Ouarzazate plants for 40 per cent reduction of CO2 in some giant countries (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
United States	26-28[i]	2100	3200
China	None[ii]	0	3300
EU28	41-42	2300	2300
India	None[ii]	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Australia	26-28	130	190
Russia	None[iii]	0	940
World	N/A	N/A	16000

Note: 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.

It will of course be argued against such a 40 per cent speedy reuction in CO2s that it leads to economic recession. So may it be! But it would reduce future much higher costs. After all, economies adapt and will recover due to all new investments needed in a decarbonised world. Ramesh (2015) emphasizes that India needs much eonomic assistance for decarbonisation – a giant task for global coordination to assist poor nations! Let us look at the American scene in Table 2.

Table 2. *Number of Ouarzazate plants necessary for 40 per cent reduction in CO2 (Note: Average of 250 - 300 days of sunshine per year was used for Canada, 300 – 350 for the others).*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Canada	30	230	300
Mexico	25	120	200
Argentina	None	0	80
Peru	None	0	15
Uruguay	None	0	3
Chile	35	25	30

Note: 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.

Some Latin American countries have lots of hydro power, but it may dwindle rapidly due to abrupt climate change. Solar power would be excellent energy for Mexico and Brazil for example. Table 3 has the data for the African scene with a few key countries, poor or medium income. As they are not in general energy consuming on a Grand scale, like Asia, decarbonisation should be feasible with Super Fund support.

Table 3. *Number of Ouarzazate plants necessary in 2030 for 40 per cent reduction in CO2 (Note: Average of 300 - 350 days of sunshine per year was used).*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Algeria	7-22	2100	3200
Egypt	None	0	3300
Senegal	5-21	2300	2300
Ivory Coast	28-36 [iv]	0	600
Ghana	15-45 [iv]	460	700
Angola	35-50 [iv]	180	170
Kenya	30 [iv]	120	170
Bostwana	17 [iv]	130	190
Zambia	25-47 [iv]	0	940
South Africa	None [iv]	N/A	16000

Note: 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.

Table 4 shows the number of huge solar parks necessary for a few Asian countries.

Table 4. *Number of Ouarzazate plants necessary for 40 per cent reduction in CO2s. (Note: Average of 250 - 300 days of sunshine was used for Kazakhstan, 300 - 350 days of sunshine per year for the others).*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Saudi Arabia	None	0	150
Iran	4-12	22	220
Kazakhstan	None	0	100
Turkey	21	60	120
Thailand	20-25 [iv]	50	110
Malaysia	none [iv]	0	80
Pakistan	none [iv]	0	600
Bangladesh	3,45 [iv]	2	18

Note: 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.

Given the economic advances in Asia, most countries need a lot of solar power parks for decarbonisation. The COP21 management would be able to help. Finally, we come to the European scene.

Table 5. *Number of Ouarzazate plants necessary for 40 per cent reduction in CO2s (Note: Average of 250 - 300 days of sunshine per year was used)*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Germany	49[v]	550	450
France	37 [v]	210	220
Italy	35 [v]	230	270
Sweden	42 [v]	30	30

Note: 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 turn to renewables in Europe occur at the same time as atomic power stations are going to be closed, at least in some countries. This makes solar power plants even more relevant, a coal power must be abolished, rather sooner than later.

Conclusion

Time has come for halting and reducing CO2 emissions by real implementation and not utopian dreams of a sustainable economy (Sachs, 2015).

There is nothing to wait for any longer (Stern, 2015), as the COP23 must set up the promised Super Fund. No time for politicking in the UN any longer (Conca, 2015; Vogler, 2016). It must be underlined that the ultimate responsibility rests will the state and their governments. There is no one single policy approach that "we" must take. Each government has to present its plans and specific situation to a Cop21 managing board.

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7 Asia and climate change: How it will play out from the Bosporus to Djakarta

Introduction

Global average temperature will most probably be larger than the COP21 objective of plus 2 degrees Celsius. At what point on the temperature scale, we move into Hawking irreversibility is not known. But a rise beyond + 4 degrees will have dramatic consequences for the ecology and human social systems.

A few days before the start of the UN global environment reunion COP23 (6-13 November 2017) in Bonn, the major study Climate Science Special Report: Fourth National Climate Assessment (USGCRP, 2017. [Retrieved from])) was published in Washington. It examines the global warming problematic from the point of view of the US and the world, based upon years of research by a large group of US scholars. It presents an impressive list of climate change impacts upon the US territory and points decisively at human causes.

The Asian continent has taken over economic leadership from the Atlantic region. Now, roughly 60 per cent of global GDP comes from Asian countries, planning large increases in energy consumption up to 2040, resulting, most likely in massive CO2 emissions, globally.

The Global CPR: COP21 as a Common Pool Regime

All 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 decarbonisation plan includes:

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

ii) Decreasing the CO2s by 30-40% by 2030 (GOAL II) – relatively or absolutely?

iii) More or less full decarbonisation 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 renege like the US?

Energy emissions

The greenhouse gases (GHG) have a strong 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 emission of methane from land sinks, cows, microbes, fracking, etc. (Stern, 2007, 2015: Sachs, 2015). The UNFCCC has focused on halting CO2s and decreasing them in a gigantic decarbonisation policy globally in this century.

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. Figure 1 shows the global connection between energy consumption and CO2 emissions.

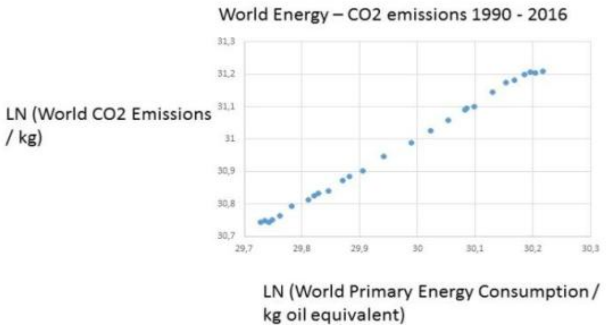


Figure 1. *Energy and CO2: s: y = 1,01x; R^2 = 0, 99*
Source: BP Statistical Review of World Energy 2017, [Retrieved from]. Janssens-Maenhout, *et al*, 2017.

There is a one-to-one relationship over tim e between energy consumption and CO2 emissions. The Asian continent is the largest GHG emitter of all continents on Planet Earth.

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 since1980, as well as further widening to all of South East Asia and South Asia plus Kazakhstan.

This economic revolution has made Asia the set of factories of the world, raising affluence and wealth as well as diminishing poverty. The cost is clear, as the Asian Development Bank states: 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 has its solution to the energy-emission conundrum, namely carbon capture or sequestration. However, it is a costly and flawed technology for removing CO2s. It will push the GHG problem to the Earth's crust, but it will not go ways. The same applies to the hope for an environmental Kuznets' curve.

No Kuznets' Curve for CO2s

Figure 2 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.

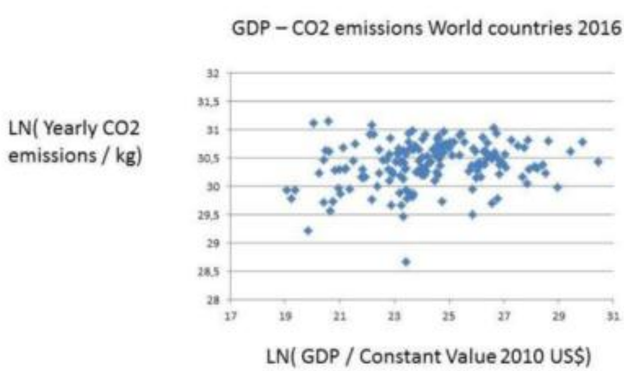


Figure 2. *GDP-COP for all countries*

Asia's "Taking-off" and "Catching-up" nations

The CO2 emissions go with GDP growth, as the intermediate link is the ever expanding energy demand. Several Asian economies are now either mature, *catch-up* or *taking-off* economies (Rostow, 1960; Barro, 1991; Barro & Sala-i-Martin, 1992, 1995). They want further economic expansion or socio-economic development, in order raise living standards.

Whether an Asian country like those in South Asia, Kazakhstan or Iran is "taking off" or if they have already come to the "catch-up" stage, like China and Turkey, they need ever more energy. In addition, the already mature economies in Asia, like Japan, South Korea and Singapore and the Gulf states, also project energy increases. Figure 3 has the global scene, with regional distributions.

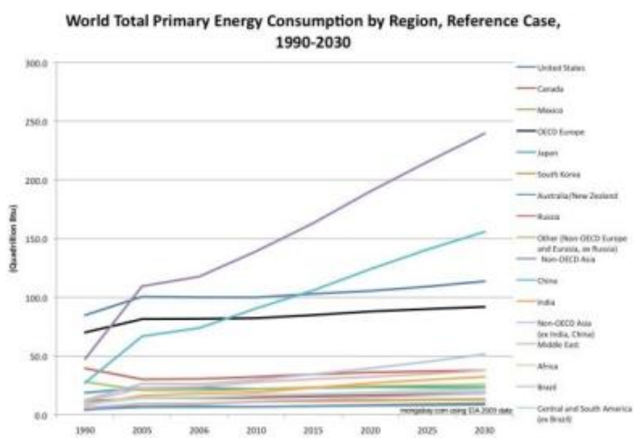


Figure 3. *Energy 1990-2030*
Source: [Retrieved from].

Figure 3 informs about the increasing energy need in the world up to 2030 when the GOAL II in decarbonisation is to be fulfilled, according to COP21. Thus, we have decarbonisation as well as more energy demand. Only huge solar power parks can solve this contradiction. Figure 2 also shows the large role of Asian countries in this energy-emissions complex, whether it is a "taking off" nation like the Philippines or Vietnam, a "catching-up" nation like Thailand or Malaysia, or finally a mature economy like Japan.

Water: Global warming negative outcomes

The process of climate change deteriorates the life situation for human beings through its impact upon fresh or potable water that is reduced. Water is a most important source of life and energy for humans.

A. Fresh or Potable Water

Access to fresh water is absolutely essential to man and woman on a daily basis. But in Asia the rivers and lakes are shrinking and the ground water levels are to be found at deeper and deeper levels. Moreover, the water retrieved thus is often polluted. One explanation is global warming, directly and indirectly. Potable water is the foundation of life and social systems. But fresh water is dwindling, as governments may have to turn to desalination plans, which though are very energy consuming.

In Asia, fresh water used to be abundant in the huge rivers and lakes. But global warming means evaporation. Moreover, social developments have put an enormous pressure on water assets: population increase, dam construction, overfishing and pollution from sewage and waste. The great rivers are shrinking; Euphrates, Tigris, Indus, Brahmaputra, Ganges, Mekong, Yangtze, Yellow River, Irrawaddy Rive, The Salween, The Red River, etc. Several dams lack sufficient water, but more are planned or under construction.

Groundwater levels are also shrinking, as one is forced to drill deeper and irrigate more. Moreover, groundwater is found often to be polluted, salty or arsenic. Asian lakes are also shrinking and suffer degradation of water quality, like e.g. the huge Caspian Sea, or Inle Lake in Burma. Overfishing in the lakes is omnipresent. Water scarcity is a lethal threat to local people in many Asian countries and it limits the usefulness of dams for electricity generation. Water quality deterioration will force ecology refuges to move to the urban areas. Drilling deeper requires energy, now often with solar pumps. But the risk of depletion is apparent. And building huge desalination plants will be extremely energy demanding. But water is basic necessity.

B. Water Quality in the Oceans and Seas

Many Asian countries have large fishing communities. Their income goes down due to overfishing and deoxygenation. This is another group of ecology refugees in the making besides poor peasants. The deterioration of the oceans is terms of oxygen is combined with enormous littering and oil spills. In addition, ocean water temperature is increasing, pushing fish stocks lower. Fish diminish in size by malnourishment and stocks are depleted by overfishing, having ripple effects on marine life.

Cop requirements and emissions in a few Asian countries

The COP Treaty makes several demands upon the signing states. First, they must make sure CO2 emissions begin to fall. Second, they must reduce CO2s by 25-40 per cent of the 2005 level up to 2030. Thirdly, they should arrive at more or less total decarbonisation by around 2075. Given the close association between CO2s and fossil fuel energy, the decarbonisation promises can only be fulfilled by reductions in the burning of coal, oil and natural gas. Below we look at the GDP and CO2 links in a few major Asian economies, from Bosporus to Djakarta. Are there plans to engage in strong decarbonisation?

The Catch-up Strategy

Turkey

Turkey has never been politically stable, neither today nor historically speaking. The Ottoman Empire was an example of oriental despotism, namely *sultanismus*. When the Young Turks set up modern Turkey, they failed to stabilize the country with a permanent constitution. The many constitutional changes reflect not only *coup d'état*, but also a weak tradition of the *Rechtsstaat*. Economically, things are entirely different, as Turkey is one of giants of the global economy, especially important with connections to the West and dominance in Turkestan.

Comparing the picture for Turkey with that of "catch-up" nations, one may state that Turkey has the typical GDP-GHG link, despite lots of hydro power. Strong economic development is combined with heavy emissions increase. Since the world organisations – the UN, WB and IMF – opt for more of economic growth, one must ask whether emissions growth really can be halted. Figure 4 supports this picture of Turkey as an energy consuming giant.

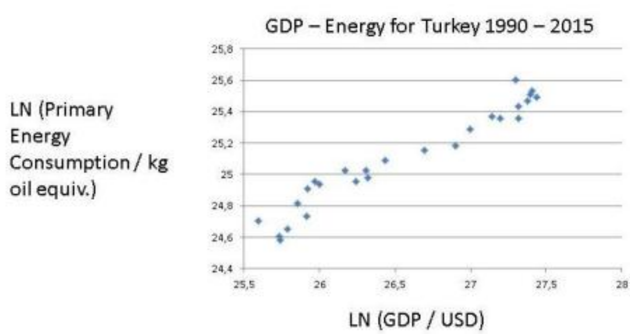


Figure 4. *Turkey: energy-GDP link*

Strong economic development is combined with heavy energy-emissions increase. Oil and gas are imported from the East. Only hydro power is a large internal source of energy. Wind energy has become fashionable, but solar energy would be an ideal solution. Figure 5 displays the stil heavy reliance of Turkey on fossil fuels, mostly imported. Decarbonisation according to the COP21 Treaty implies that

Turkey must change drastically, as it now depend at 90% on fossil fuels.

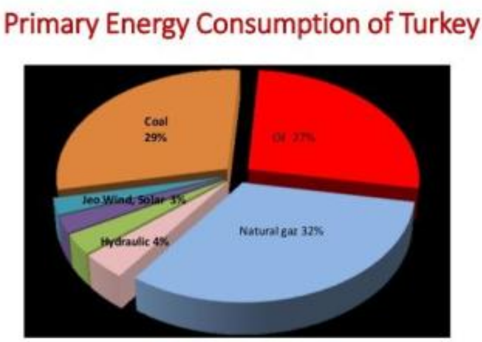


Figure 5. *Energy mix in Turkey*
Source: [Retrieved from].

Turkey pursues the "catch-up" strategy in relation to the advanced capitalist countries (Barro, 1991, Barro & Sala-i-Martin, 1992, 1995). It is not very eagre to take on the burden for global decarbonisation, especially if it hurts their economic development. They would demand compensation from the promised Super Fund, as Turkey has now threatened to regene upon its COP21 promises.

China

It is alarming information that China, the biggest emitter of CO2s, will not succeed to halt its curve for CO2s. Instead, it counts upon some 3 per cent increases the nearest years – see Figure 6.

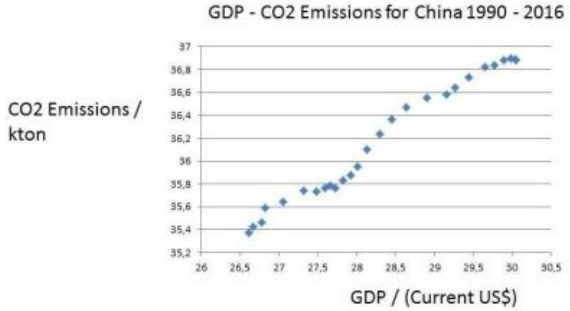


Figure 6. *China: GDP and CO2s: y = 0,46x, R^2 = 0, 98*

China has officially declared that it intends to meet both COAL I, halting the increase in CO2s, and GOAL II, reducing CO2s by some 30 per cent. But promises and intensions are one thing, real life developments another matter. All countries in this CPR can at any time renege, the US has already done.

China is well wall if huge pollution problem, making Beijing almost inhabitable some days. It invests heavily in both nuclear power and modern renewables. At the same time it keeps up its economic expansion in order to catch-up with the West:

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

Air transportation adds much to CO2 emissions. Even if electrical cars are launched massively in China, one must ask where the electricity comes from. Coal? Can China, or will China really comply with the COP21 objectives, listed above? Look at one standard coal projection – Figure 7.

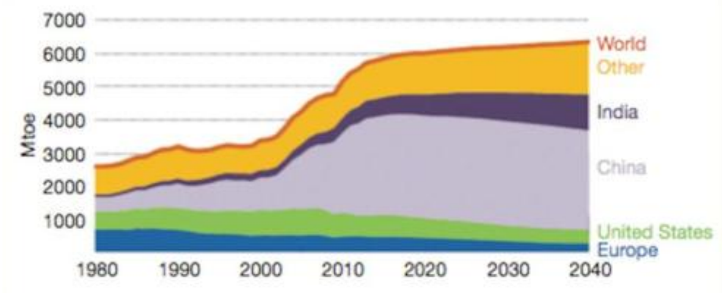


Figure 7. *Global coal projections*
Source: [Retrieved from].

The Take-off Strategy

India

Its Rostow 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.

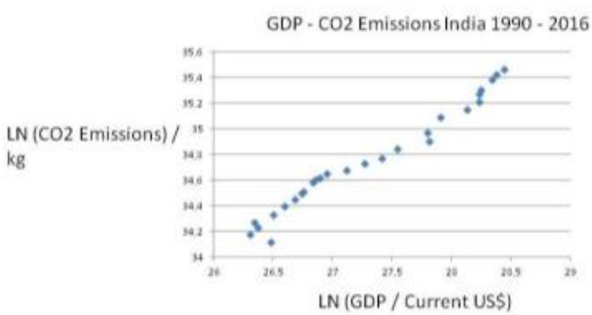


Figure 8. *India: GDP and CO2*

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.

As Ramesh (2015) explains, 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.

Iran

Iran has had several take-off points in time, but these occasions have been arrested by political reversals. Now, Iran prepares its strategy of catch-up, first with the Sunni Arab world and later with the West. Energy in Iran is all about fossil fuels: oil and gas. And the CO2s are high for Iran – Figure 9.

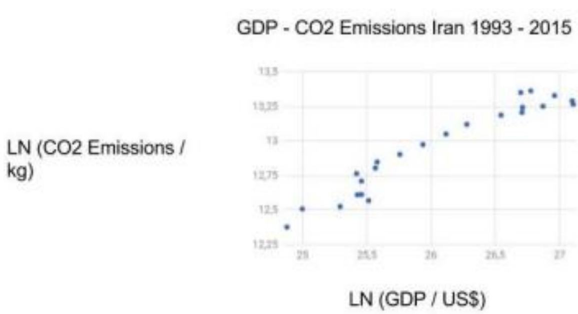


Figure 9. *Iran*

Iran will have to renege on COP21 objectives, unless receiving support from outside. The solution is apparent: solar power parks (Figure 10).

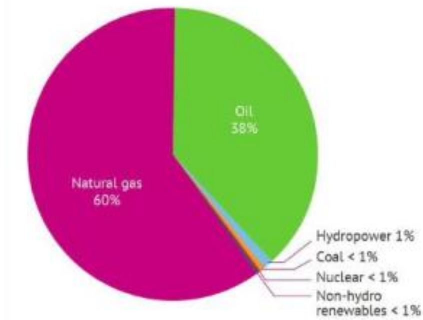


Figure 10. *Energy mix in Iran 2014*
Source: Energy Information administration, 2014

Indonesia

Indonesia has rapidly moved up as a major consumer of energy in the early 21rst decade., refelcting growimh political stability and a strong effort to catch-up with the other Asian miracles. It has definitely passed its "take-off" stage, but interestingly its enormous consumption of energy has not been accompanied by high economic growth in most recent years (Figure 11).

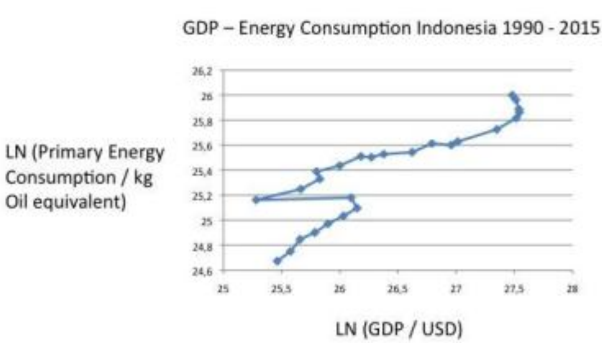


Figure 11. *Indonesia GDP-energy: y = 0,46x; R^2 = 0,79*

The inward and upward sloping curve for Indonesia must be of concern to the elite in the country, because Indonesia has become a major contributor to CO2 emissions. If economic growth stalls due to inflation, then how to defend the enormous emissions?

The bad CO2 emissions stem partly from the cutting and burning of rain forests and adjacent land on Kalimantan and Sumatra, which the government is to weak to control. The illegal fires affect other neighbouring countries but little is done to stop them. The search for more land for agriculture, especially soya planations, drives the externality. Emissions even outpace energy consumption. These rain forests are bound to disappear, as the Indonesian state does not have the capacity or even willingness to police these huge areas. One may guess correctly that countries that try hard to "*catch-up*" will have increasing emissions. This was true of India. Giant Indonesia is now the fourth largest emitter of GHG:s in the world (Figure 12).

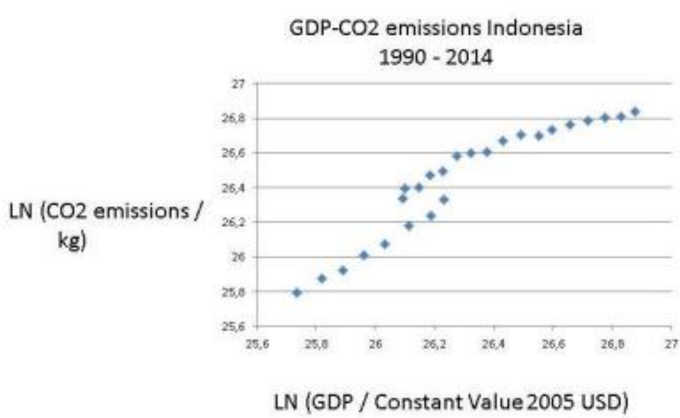
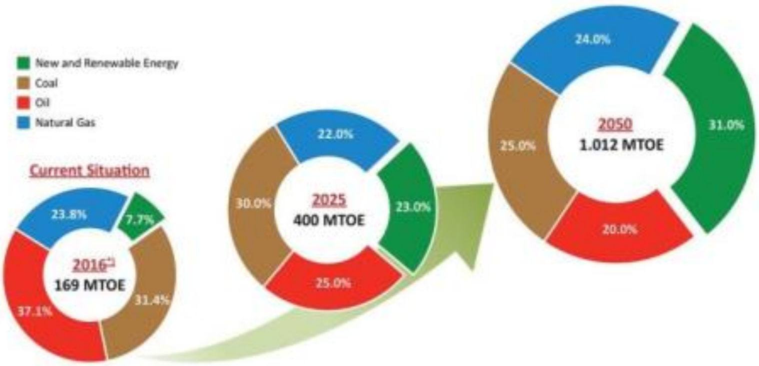


Figure 12. *Indonesia: GDP-CO2 link: y = 0, 95x + 1, 58; R^2 = 0, 89*

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 augments the GHG emissions very much. Only 4 per cent comes from hydro power with 70 per cent from fosil fuels and the remaining 8 per cent from biomass, which alas also pollutes (Figure 13).



	2016	2025	2050
NRE Mix	7.7 %	23%	31%
Energy Supply	169 MTOE	400 MTOE	1.012 MTOE
Generation Capacity	59 GW (NRE 8 GW)	136 GW (NRE > 45 GW)	443 GW (NRE > 167 GW)
Electricity/Capita	956 kWh	2.500 kWh	7.000 kWh
Electrification Rate	91%	~100%	~100%

Figure 13. *Indonesia's energy mix*
Source: [Retrieved from].

Here, we see the weakness of GOAL II in the COP21 project: absolute or relative reduction of CO2s? Indonesia plans an enormous increase in energy supply with sizeable renewables and hydro power, but the burning of fosil fuel will increase *absolutely*, due to the giant energy supply growth. Moreover, also lakes in Indonesia are shrinking and increasingly polluted.

Kazakhstan: Oil and Gas

Here, we have a nation very much occupied with the catch-up strategy, as its exit from the Soviet Union worked like a "take-off" stage. It wants to copy the Asian miracles, moving to affluence in a few decades, using its immense fossil energy resources (Figure 14). But this picture of over 90%

fossil fuels is very far from the obligations under the COP21 Treaty.

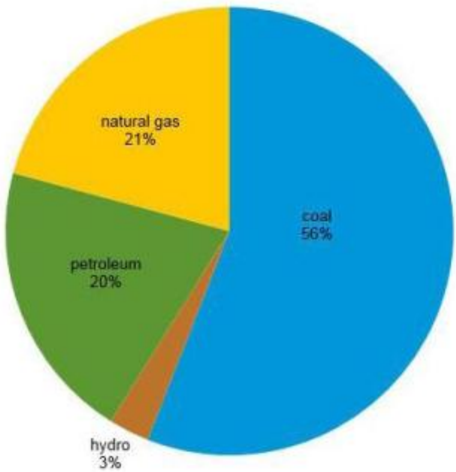


Figure 14. *Energy mix*
Source: U.S. energy information administration

Kazakhstan's energy consumption leads to enormous emissions. The stunning economic development, including the great project of a modern Silk Roan from China to Turkey through Kazakhstan implies that the CO21 goals cannot be accomplished here. Catch-up strategy and huge infrastructure trump climate change. Countries with no hydro power often display increasing trends for emissions. Kazahkstan employs its vast fossil fuel resources for energy consumpton besides exporting a lot. But it has to start energy transformation towards renewables

Asian mature economies

South Korea is today a member of the club of First Advanced economies, the OECD. From dismal poverty, it has pursued a spectacularly successful catch-up strategy, making it a global leader in technology and car production. The transformation is all the remarkable, as the country possess few internal power resources. Thus, it has relied upon imported fossil fuels, with the result in Figure 15, huge CO2 emissions.

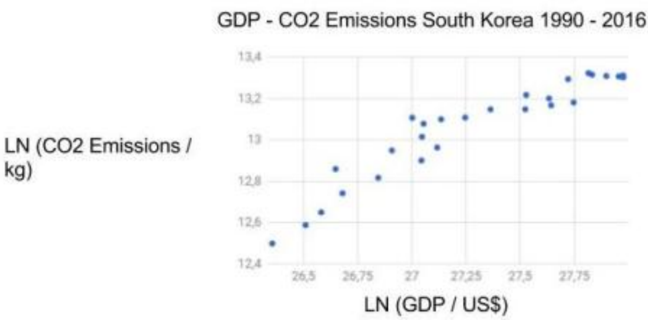


Figure 15. *South Korea*

To come to grips with its enormous GHG emissions, South Korea has attempted to reduce its coal dependency. Thus, it engaged upon a most ambition nuclear program, as its force is the largest power source in the world. South Korea with its advanced technology can build new and better as well as safer atomic power plants, also constructing them abroad. But the new president hesitates about nuclear power, like the European governments, and has launched a new energy strategy based massively upon natural gas (LNG), imported mainly from Australia and Indonesia. But it will still result in CO2 emissions higher than GOAL II in CO21. And international maritime transportation is a major source of CO2s.

The LNG option may also appear attractive to Japan, hesitant about the use of atomic power. The Fukushima atomic power plant disaster changed energy policy in Japan, with an almost %-stop of nuclear plants. But what use in Japan? See a plan in Figure 16

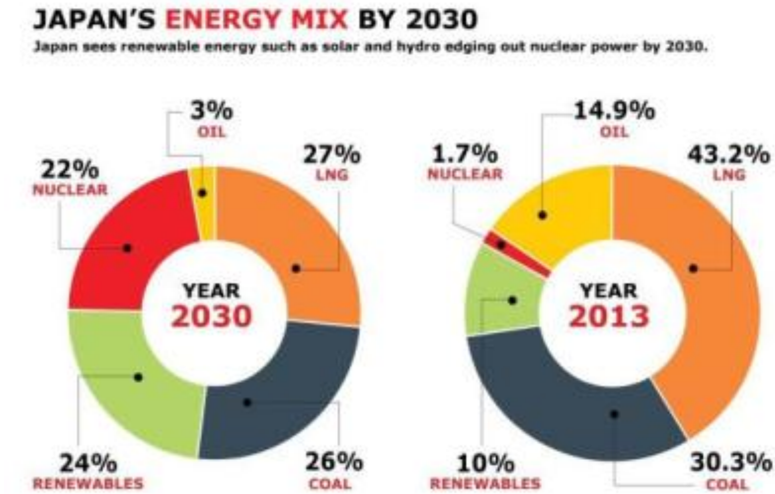


Figure 16. *Japan's future energy mix*
Source: Ministry of economy, trade and industry, Japan, 2015

This plan relies upon a big return to nuclear power, as there are safer models now. But is it politically realistic? If not, Japan must increase imports of fossil fuels, and renege upon COP21.

CO2s and Methane

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. Figure 17 shows how CO2 emissions may raise temperature to 4-5 degrees – the Hawking irreversibility point:

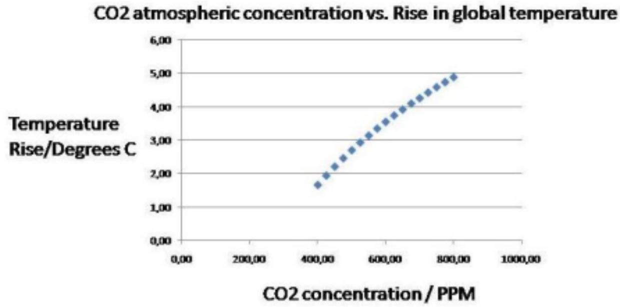


Figure 17. *CO2s and temperature rise in Celsius*

The most important contribution to the recent rise of methane concentration is mainly due to the increase in activity by microbes. 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. 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 will not decrease with temperature for many years, increase in landfills;

c) Fossil fuel production and use will not diminish yet, and is underestimated by industry, fracking (Fred Pearce, [Retrieved from]).

d) Biomass burning will 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.

e) Other natural emissions A projection for methane emissions is done in Figure 18.

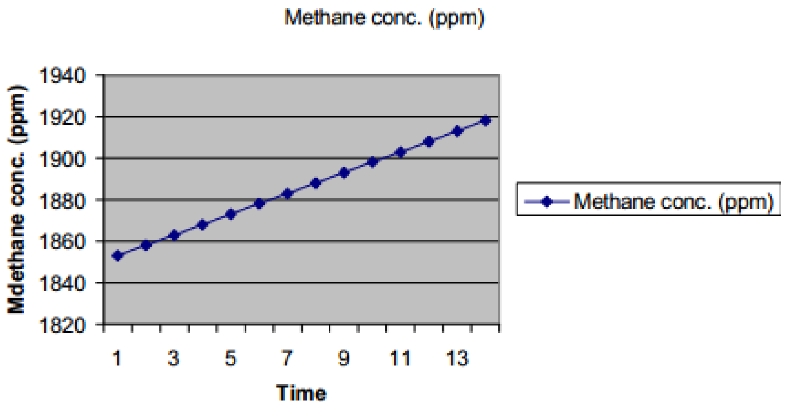


Figure 18. *Projected increase in methane (Dieterlen)*

Decarbonisation Strategies

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 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;

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, Kongo Basin, 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 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. If global warming becomes really bad, all these radioactive materials could be released back in our social systems and nature. Some countries expand atomic energy, whereas others dismantle it.

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?

9) Table 1 has an 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)

Table 1. *Number of Ouarzazate plants for 40 per cent reduction of CO2 in some giant countries (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
United States	26-28[i]	2100	3200
China	None[ii]	0	3300
India	None[ii]	0	600
Japan	26	460	700

South Korea	37	260	280
Phillippines	70	70	40
Indonesia	29	120	170
Saudi Arabia	None	0	150
Iran	4-12	22	220
Kazakhstan	None	0	100
Turkey	21	60	120
Thailand	20-25 [iv]	50	110
Malaysia	none [iv]	0	80
Pakistan	none [iv]	0	600
Bangladesh	3,45 [iv]	2	18
Australia	26-28	130	190
World	N/A	N/A	16000

Note: 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.

Conclusion

The Asian continent has become the leader of the global market economy, demanding enormous amounts of energy, which results in Asia having more than 50% of global CO2. But Asia does not possess a highly sustainable environment to be able to handle the outcomes of climate change. For instance, rivers and lakes are shrinking, glaciers are melting, creatures in oceans and seas suffer from increase deoxygenation and asphyxia. Sea level rise is observable in island states and Bangladesh e.g. Hoter temperature on land and in sea hit both agriculture and fishing, meaning food in Asia. A stream of environmental refugees is foreseeable.

Despite the adherence to the COP21 Agreement and the forthcoming of several local innovations in energy supply, the reliance in Asia upon fossil fuel is massive. And it will hardly go down much, because Asian nations are committed to the "take-off" and "catch up" strategies. We may have to wait too long before Asian nations start real decarbonisation (Stern, 207, 2015). Only water scarcity and degradation will trigger a fundamental change.

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8 The beginning of the end of the climate drama

Introduction

The prospects for decarbonisation halting climate change seems grim, especially if abrupt climate change theory is correct. The crux of the matter is energy, which still comes with a high corbon intensity in most countries. Energy is the capacity to do work, which is the foundation of affluence. Figure 1 brings this fact out clearly for 2017.

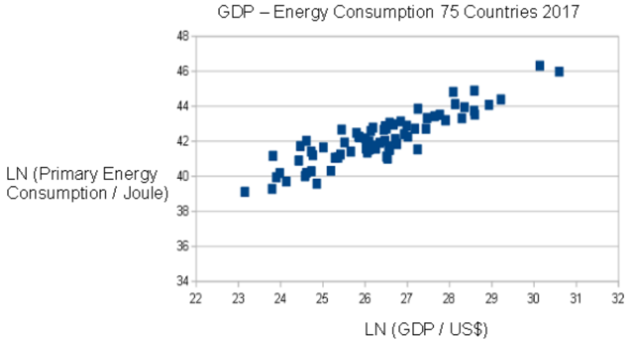

Figure 1. *GDP and energy for the globe 2017*

Sources: Bp Statistical Review of World Energy World Bank Data Indicators

Note. R2=0.81

Coordination failure

The COP21 Treaty, or any other similar agreement, would have two parts:

i) reduction of CO2 emissions ina certain pace towards zero emissions at some future date;

ii) contributions to the Super Fund yearly according to some scheme and time table.

Both these two actions concern first and foremost the countries in the G20 group of nations, responsible for 70 per cent of the total CO2 emissions. Small poor nations can be left beside, as they pollute little and cannot be required to pay into the Super Fund.

Both i) and ii) are just promises, which the COP21 Secretariat or the UN cannot enforce, strictly speaking. When a country receives support the Super Fund, there is some leverage to force obedience. However, a big poor country may simply refuse decarbonisation, if no assistance is provided.

Decarbonisation is costly in the short run for all countries, as the must replace existing energy plants with new, hopefully renewable energy resources. Contriuting to the Super Fund is also costly in the short run. This sets up an interaction where a government may be tempted to defect from its promises to decarbonise or pay to the Super Fund.

A. Stratey of poor nations: the N-1 problematic. Poor or small nations will engage in opportunism with guile in order to avoid too large costs with the COP21 decarbonisation policy, pretending they matter very little for outcomes.

B. Strategy of the rich country: the 1/N problematic. Large or rich countries will find sacrifices that cannot be internalised as meaningless gifts to others, who may not be trusted to cooperate. Thus, the US reneged because it did not want to pay for decarbonisation in India. The PD nature of interaction in a global CPR like the COP21 Treary is fragile, to say the least. What is lacking is the instruments of control, as Hobbes pointed out already 1651 in hid Leviathan, speaking of voluntary agreements or accords: *"Covenants, without the sword, are but words, and of no strength to secure a man at all,"*

Ineffective resilience

Governments only pay lip service to the threat of human extinction. It is business as usual among the Great Powers, in the Middle East and South China Sea, in markets and financial institutions. This is not what climate and earth scientists would predict, but it is in accordance with social science theories of collective action. No time for utopian experiments, as time is tight (Stern, 2007, 2015).

The chart below shows carbon intensity (fossil fuels/all energy) for a selection countries in the world. This is root cause of abrupt climate change, threatening mankind. The mean is as high as 85 %.

Chart of Carbon Intensity

Norway	31,1%
Sweden	33,4%
Switzerland	52,1%
France	53,5%
Finland	55,8%
Brazil	62,9%
New Zealand	63,1%
Canada	65,0%
Austria	67,5%
Colombia	68,6%
Ecuador	71,6%
Peru	72,8%
Ukraine	73,5%
Spain	76,2%
Romania	76,3%
Vietnam	78,8%
Chile	78,9%
Belgium	79,0%
Czech Republic	79,4%
United Kingdom	80,0%
Germany	80,2%
Portugal	80,9%

Hungary	80,9%
United States	84,2%
Italy	84,8%
China	86,4%
Sri Lanka	86,5%
Argentina	86,6%
South Korea	87,2%
Turkey	87,4%
Russian Federation	87,4%
Philippines	87,9%
Pakistan	88,1%
Greece	88,7%
Japan	89,7%
India	91,9%
Mexico	92,6%
Taiwan	93,5%
Uzbekistan	93,7%
Australia	93,7%
Netherlands	94,0%
Malaysia	94,0%
Morocco	94,6%
Poland	94,7%
South Africa	95,2%
Indonesia	95,9%
Egypt	96,0%
Kazakhstan	96,1%
Thailand	96,6%
Azerbaijan	96,9%
Iran	98,0%
Israel	98,4%
Iraq	99,0%
Bangladesh	99,1%
Belarus	99,5%
Singapore	99,7%
Algeria	99,8%
United Arab Emirates	99,9%
Qatar	99,9%
Hong Kong	99,9%
Kuwait	100,0%
Saudi Arabia	100,0%
Trinidad & Tobago	100,0%
Turkmenistan	100,0%
Oman	100,0%

Sources: BP Statistical Review of World Energy

The crux of resilience as strategy is energy, which still comes with a *high corbon intensity* in most countries. Energy is the capacity to do work, which is the foundation of affluence and human development.

The anthropossene period: Likely end of mankind

Scholars now say we face a new period in the history of human beings on Earth, the anthroposcene replacing the holoscene period. It would be characterised by mankind's domination over Nature, resulting in a quite new climate and ecological degradation. Yet, one could retork that it is now Nature that shrinks the degrees of freedom of men and women, making them victims of Nature's unpredictability and violence.

In this perspective, the holoscene period antedating the anthroposcene beginging arund 1700, lasted for thousands of years. How long will the anthoposcene period last? The COP21 Accords were based on a belief that time was available for a slow decarbonisation, managing global warming at around + 2 degrees Celsius, stabilising climate sometimw 2076 – the carbon budget approach. These beliefs are now partially outdated.

Abrut climate change theory

Recently launched, climate and earth scientists now focus upon so-called tippng points as well as the great variability in temperature increases over the entire globe. The dramatic changes in the Arctic have made researchers focus upon the melting of the ice at the poles and Greenland and its repurcussions for global weather and the huge methane holdings in the permafrost from Alaska to Siberia, both on land and in ocean.

a) Tipping point 1: Arctic Sea ice; Expected to disappear around 2020, it will not increase sea levels dramatically due to the eqivalence between ice and water. But this will affect global oceans streams as well as global weather yet streams.

b) Tipping point 2: Greenland ice; Uncertainty when it will be gone – some say 1940, this will raise sea levels some 6 meters. Major city areas will inundated: Miami, Rio de Janeiro, Venice, Kairo-Alexandria, Mumbai, Hanoi, Shanghai, Tokyo and Singapore, for instance. It would further deteriorate oceans conveyor belt and the slow the global yet stream.

c) Tipping point 3: Antartica ice mass; this enormous mass of ice and glaciers would be finished by some 100-500 years, rising sea levels some 60-70 meters. Mankind stand to loose a lot of land all over the planet Earth – a true catastrophe.

d) Tipping point 4: constant heat increase with draught and potable water scarcity. This would reuce food availability and lead to millions of climate refugees from vunerable low level coastline countries and poor nations along the equator.

e) Tipping point 5: Methane emissions from the melting permafrost. This threat is so huge that mankind would never survive such a major release of CO2s. The idea of so-called tipping points is that it make concrete the Hawking notion of irreversibility.

Irreversibility: Its entailment

When S. Hawking suggested that climate change was irreversible, he was met wih sharp citicism. The notion of an irreversible process of change comes from the theory of scientific laws of nature with their universality and empirical necessity. If global warmin is unstoppable or inevitable, then the survival of the human race is at stake. The only way to reduce the speed of climate change, avoiding inevitability, is to stop pumping GHGs into the atmosphere. This requires inter alia:

i) immediate stop to coal and charcoal in poor countries;

ii) replacing fossil fuel enegy with solar panel parks of the Morroccan Quarzazate kind;

iii) initiate now large scale geo-engineering experiments to suck up CO2s or sequestrate CO2s.

Will these measures be taken by the UNFCCC or the G20 group of nations? Probably not. Why? Becaause of the ocean PD game involved. What matters to all countries and governments is access to energy, the culprint of the anthroposcene period.

Energy and human needs

The public and private sectors demand lots of energy to produce their goods and services. Energy, or the capacity to do work potentially or actually, is key in economic growth for enterprises and financula institutions in rich countries. And energy is absolutely essential in socio-econmic development in poor nations. But energy supply drives the emisions of GHGs, as energy consumption results in GHG emissions as long as fossil fuels dominate supply. Figure 2 shows most recent data abou the iron link between GDP, or economic output, and energy consumption, globally.

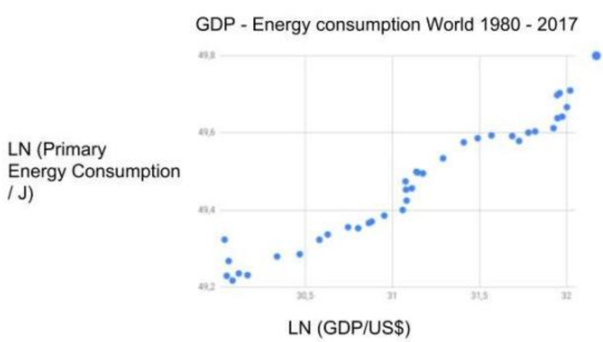

Figure 2. *GDP and Energy*

Note. R2 = 0.951

Sources: Bp Statistical Review of World Energy World Bank Data Indicators

The cental position of economic growth in rich countries and of socio-economic development in poor countries is much in consonance with basic human drives as well as with the logic of vibrant capitalism in the global market economy. Governments and politicians cherish economic growth, because it makes more policy-making possible. Look at the evidence about the positive effects of energy in the figures below, linking energy consumption with human development indicators.

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.

For instance, African countries are poor because they have too little energy. Thus, they have much less GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydro power depends upon water availability that shrinks with global warming. African energy deficit is conducive to a dire environment with enormous damages and risks. Consider the following global figures. Figure 4 shows how low energy leads to am unsafe environmental.

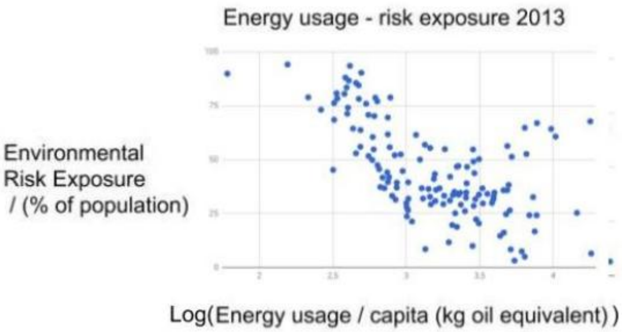

Figure 3. *Energy and environmental risk exposure*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 5 has the global picture.

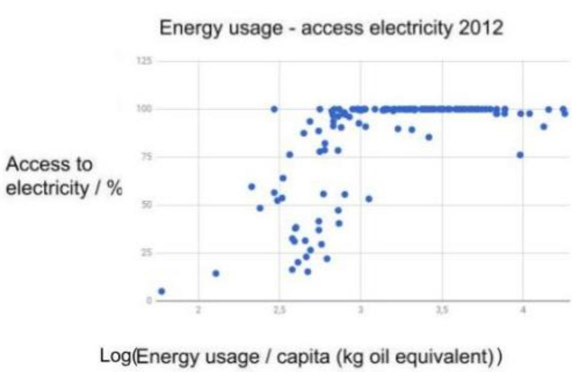

Figure 4. *Energy and Electricity Access*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 6 links energy with proper sanitation.

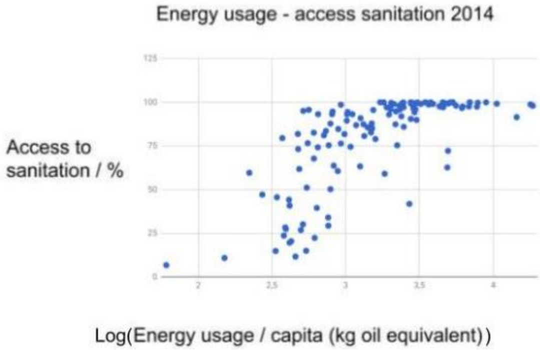

Figure 5. *Sanitation and Energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Especially, the rapidly growing African, Latin American and Asian mega-cities lack entirely proper 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 4 links energy with proper sanitation.

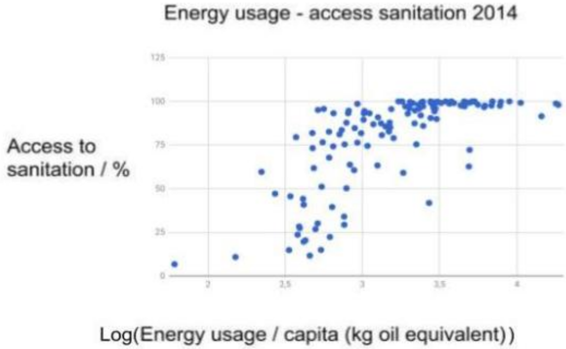

Figure 6. *Sanitation and Energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Figure 7 underscores the necessity of more energy in poor coutries for prper sanitation, without which the life of humans is "salle".

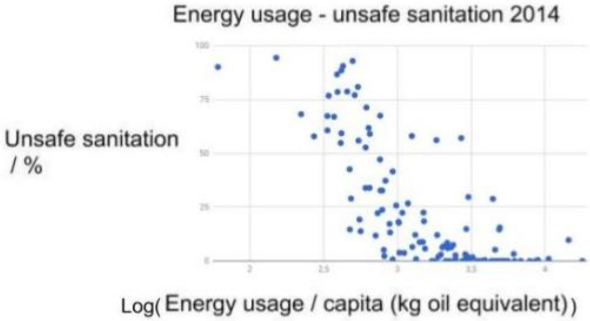

Figure 7. *Energy and Unsafe Sanitation*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Air quality too depends upon energy access (Figure 8).

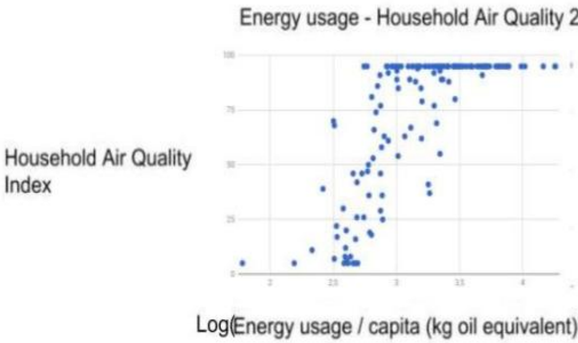

Figure 8. *Energy* and Air Quality
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Typical of many poor nations – Latin America, Africa, Asia - is the lack of predictable access to safe electricity, which hampers work and reduces environmental viability. The access to safe electricity is, it must be emphasized, absolutely central for health, schools, food, potaable 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! Given the above evidence about the positive consequences of energy for quality of life and life opportunities, one understand the position of the Third World at the Paris meeting that decarbonisation must be combined with great economic assistance to make fundamental energy transfrmation. The result was the promise if a giant Super Fund, bit it is only a promise.

Projection of energy: A few example

The decrbonisation goal of COP21 requires the support of the big countries in the world. But do they really aim at decarbonisation? We look at three examples here.

India

In Indian energy policies, it is emphasized that developmental goals take precedence over climate change considerations. Thus, all Indian household musst have access to electricity and only sustained rapid economic growth can reduce poverty. India has a "take-off" economy that delivers affluence for the first time since independence. But it is based on fossil fuels. India looks into other sources of energy, as long as socio-economic development is not hindered. Figure 9 shows the main features of India's future planning.

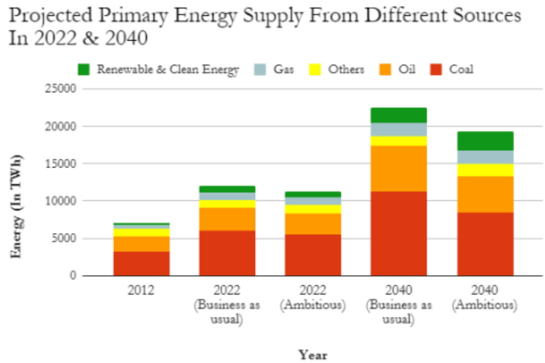

Figure 9. *India`s energy future*
Source: [Retrieved from].

India has rapidly become a major CO2 emitter due to its high growth rates since 1990. It uses lots of coal, stone or wood. Charcoal is bad for households and results in forest destruction. India tries to broaaden its energy supply to modern renewables, like solar, wind and hydro power. Yet, it will remain stuck with fossil fuels for decades. It needs assistance from the COP21 project, especially for solar power parks. Building more dams is very risky, as global warming reduces water assets. Figure 9 indicates the India cannot meet its COP21 promises, as Ramesh (2015) underlines. India shows the same close link betwee GDP and energy consumption (Figure 10).

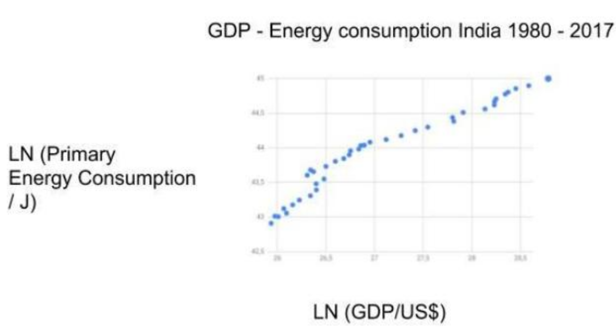

Figure 10. *GDP and energy in India*
Note. R2=0.94. **Sources:** Bp Statistical Review of World Energy.

Given this close connection between GDP and energy consumption in India, the risk is of course that further socio-economic developments will increase GHG emissions. India is hardly on the decarbomisation road.

USA

The US has reduced its CO2 emissions during the lats years, mainly by a shift to natural gas. Actually, several mature economies have been able to halt the rise of CO2 emissions, either by more energy efficiency or a shift to natural gas or renewables. Figure 11 captures some features in US energy plans.

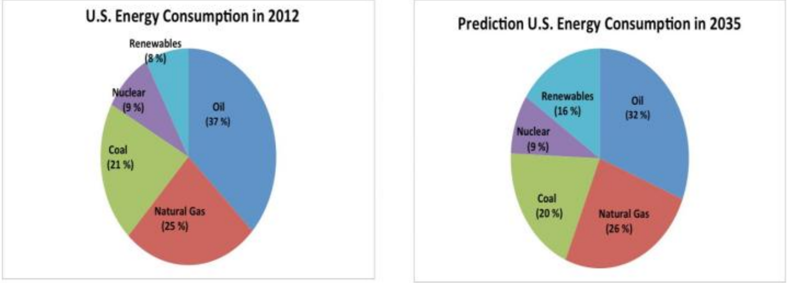

Figure 11. *US energy future*
Source: [Retrieved from].

Although the Figure 9 predicts a doubling of renewable energy, the dependency upon fossil fuels, including coal energy, will not bee much reduced. We are talking here about relative numbers, but if the US increases total amount of energy supply – fracking!, then there may even be more fossil fuels. The reduction in CO2s during recent years seems to be coming at a reduced rate. The hope is for economic growth without energy increases, but we are not there yet. And most countries demand more energy for the future.

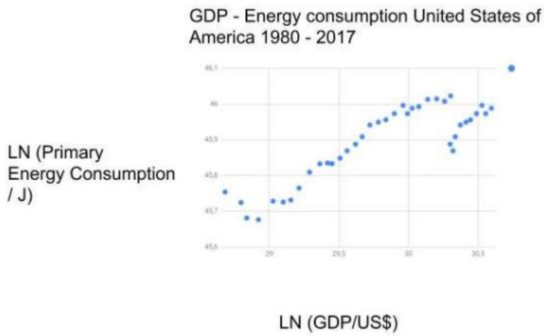

Figure 12. *GDP and energy for the USA*
Note. R2 = 0.77. **Sources:** Bp Statistical Review of World Energy

World Bank Data Indicators Although the link between GDG and energy consumption id lress tight for he USA than India, reflecting that economic growth in advanced countries can be achieved without energy increase, it is still the case that the US is not on the road towards major decarbonisation.

China

China now enters the First World, as it has long passed its "take-off" point in time around 1980 and has pursued a successful "catch-up" policy for a few decades. Its energy consumption, especially fossil fuels, has skyrocketed with GDP, resulting in the largest CO_2 emission globally. Figure 13 has a projection for China.

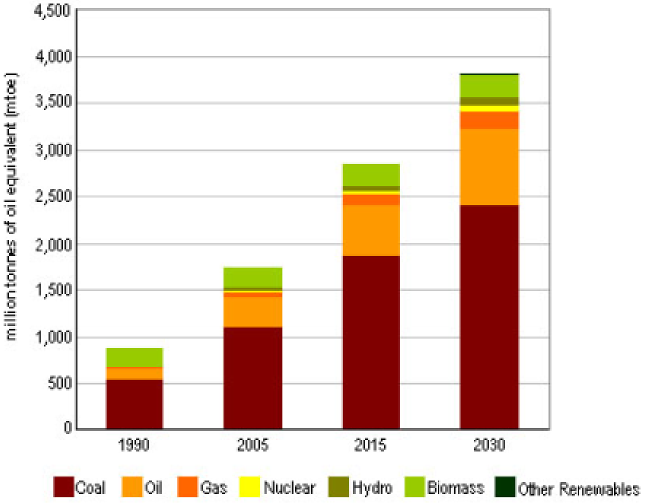

Figure 13. *Energy Projection For China*
Soruce: [Retrieved from].

Decarbonisation does not seem highly probable. Much hope was placed at a recent reduction in CO2s, but water shortages forced China to revert to coal in 2017 with attending augmentation of CO2s. China is investing in both renewables and atomic power, but it also plans for large energy increase in the coming decades with lots of energy consuming new projects.

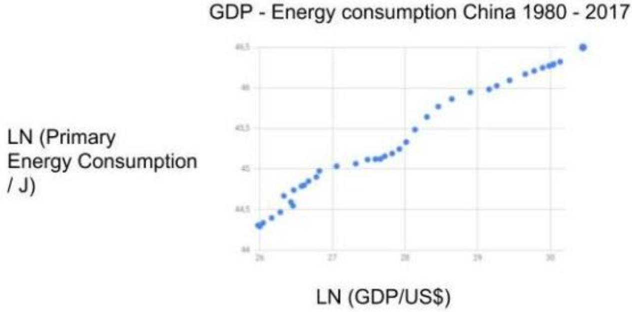

Figure 14. *GDP and energy for China*
Note. $R2 = 0.98$. **Sources:** Bp Statistical Review of World Energy World Bank Data Indicators

Such a close connection between GDP and energy consumtion in China imples that China must turn to renewables massively in order to comply with COP21 goals.

Domestic policy concerns and international coordination

A government may bind the state it repesents to farreaching objectives like complete decarbonisation at an internatinal reunion, but it is just a ”scrap of paper”. It matters really press cncerning safeguarding national interests, the goverment simply reneges. When water becomes scare for Chinese energy dams. Then coal is resorted to again, with new CO2 augmentation. Domestic politics play a major role in energy policy besides international accords. Here are three examples

a) Japan’s dilemma After the Fukushima disaster, Japan closed 50 of its 52 reactors. The country relies much upon the import of of various energy resources. Will Japanese politics allow a return ro nuclear power or will Japan like South Korea rely massively upon LNG from Australia? One possible scenario is ourlined in Figure 15-

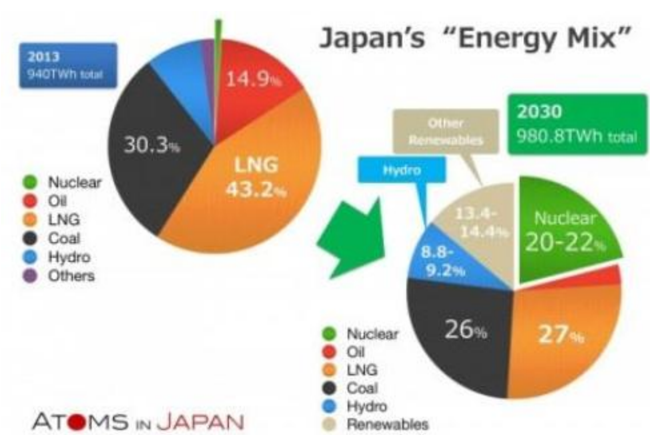

Figure 15. *Energy plans for Japan*
Source: [Retrieved from].

b) Germany & France: nucleaar distrust Despite all propaganda about so-called Energiwende, Germany remain much dependent upon fossil fuels. High grade coal is imported from Russia and Colombia to add to its own low grade coal, besides all the natural gas from Gazprom. At the same time, nuclear power are closing – all up to 2022. France is also closing nuclear plants, despite the fact that they could be used longer and made safer. Both countries should turn to solar power – see Table 1, but may be expected to burn biomass or biotrash, which emits CO2 inter alia.

Table 1. *Number of Ouarzazate plants for 40 per cent reduction of CO2 in some giant countries (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
United States	26 – 28[2]	2.100	3.200
China	None[3]	0	3.300
EU28	41 – 42	2.300	2.300
India	None	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Australia	26 – 28	130	190
Russia	None[4]	0	940
Germany	49	550	220
Sweden	42	30	30
World	N/A	N/A	16.000

Source: UN Framework Convention on Climate Change: CO2 Emission Reduction With Solar. [Retrieved from].

Notes: 1) The United Sates has pulled out of the deal; 2) The United States of America made this pledge but has subsequently withdrawn from the agreement; 3) No absolute target; 4) Pledge is above current level, no reduction.

Sweden used to be lucky with energy resources, relying upon many rivers and modern high tech and very safe nuclear power stations. However, since 2000 it now abandons nuclear power at astronomical costs, relying instead upon the import of biomass or biotrash. GHG are now increasing in Sweden. Summing up: Climate change is more lethal than nuclear power plant accidents.

Conclusion

The awareness of lethal climate change is on the increase with scientists, civil society and ordinary people. But the political elites remain myopic and opportunistic. The 21st century may be the last in the history of human beings. Why is there no action from G20 nations?

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CO2 Emission Reduction With Solar. [Retrieved from].

9 How to manage the Cop21 policies?

Introduction

Global government coordination has come so far that the UN has enacted the policy objective of almost complete decarbonisation in this century at the COP21 reunion in Paris 2015. Bur how is this formidable objective to be managed? Can the increase in GHGs be stopped before the so-called Hawking irreversible point, where climate chaos become unstoppable? To ponder about the question, so fatal for humanity, we need a theory about the increase in GHGs. Why do they continue to increase?

Thus far, the COP21 project involves a halt to the increase in CO2 emissions by 2020, a 30% reduction in CO2s by 2030 (absolutely or relatively?) and more or less total decarbonisation by 2075. But the means to these gigantic goals? It is all about managing energy transformation, as the augmentation of GHGs stems from human use of energy resources, As we get more and more dire predictions about the nature of climate change and its probable consequences, it becomes more and more urgent to clarify what the COP project can and must accomplish.

Climate change could be halted by a sharp reduction in the use of fossil fuels over night, but it would spell large scale economic crisis with mass unemployment and social upheaval.

Many climate experts now claim that we are heading for more than a + 2 Celsius increase in global warming as well as already a + 2 Celsius augmentation is a threat to human survival due to the many positive feedback loops started by such an increase. As the doomsday scenarios gather strength, it becomes absolutely vital to stick to the COP project and explore what can be achieved and how.

Policy implementation entails management

Climate experts and earth scientists talk "abrupt climate change" as well as the "methane bomb", widening the set of GHGs to focus upon methane, emerging chaotically from the melting permafrost in the Northern most part of the hemisphere or from melting ice containing frozen methane at the seabed in the Arctic. The potential amount of methane to be released in the worst case scenario is so large that global warming would quickly move beyond the Hawking irreversible point, spelling doom for mankind. The time spam for the methane bomb is uncertain, from 50-200 years. What to do? At this point in time, global coordination against climate change can only intensify its efforts at decarbonisation during the 21st century. The COP21 project has to be pursued and fulfilled in an improved version with quicker actions, complemented by other activities like carbon sequestration or Geo-engineering, if workable. Hopefully, the US will reenter this common pool regime later.

The overall objective of the COP21 project from Paris 2015 is to start decarbonisation by 2020 and finish it by 2075. A necessary condition is that states conduct energy policies that eliminate coal and start solar power parks. This requires enormous management skills by individual governments with support from global coordination agencies or committees. A drastic policy tool is carbon sequestration or capture, but it is hardly viable at the moment. Climate engineering may add to the basic means: abolition of coal and big solar power parks.

Theory: The basic hypothesis is the strong link between CO2 emissions and global temperature – Keeling' curve. Only by halting CO2 emissions first and then start reducing them can global warming be stopped and the methane bomb avoided. This is the foundation of the COP21 project and the possibility of geo-enginering may be an option as time goes by.

Implementors: The COP21 secretariat comprises some 450 persons, planning new global reunions, and monitoring the development of the country engagement for the Treaty as well as negotiating the promised reductions in CO2s. It could be turned into a management agency assisting countries cut CO2s on the basis of interaction the Intergovernmental Panel for Climate Change (IPCC).

Management tasks: Each country needs to develop a decarbonisation strategy, involving the crucial steps in the necessarily giant energy transformation from fossil fuels to renewables, given the most recent information available about energy and its presuppositions. The COP21 secretariat could be helpful in designing the best projects and come up with cheap funding avenues, guaranteeing loans below market rates. It could make recommendation about carbon tax and renewable energy subsidies.

Competences: A reinforced COP21 developing into the management of global decarbonisation would act as an agency of first the UNFCCC and second as the agent of the principals of the UN, viz. the member states. Its tools of management would be persuasion, oversight, recommendations, negotiations, but not authority or interference.

The new climate debate: "Already too late"

Among some climate scientists, there is recently a new urgency. The melting of the North polar ice is advancing so quickly that all projections about temperature rise on the Earth must be revised upwards. Quicker warming sets in motion very positive feedback s that threaten human survival. The goal of COP21 – limit global warming to + 2 degrees Celsius – is no longer achievable. Instead, climate chaos seems more likely. A few predict that mankind has no more than 10 years before things become unmanageable. When the North pole ice is gone, global warming goes much higher than + 2.

The theory that climate change is now becoming irreversible is based on new hypotheses concerning the consequences of global warming:

- sea level rise and Arctic ice meltdown is quicker than believed;
- climate refugees may rise to 100 million people;
- food and water shortages come earlier than believed;
- the + 2 degrees Celsius target is misplaced as the Earth warms differently at various regions, i.e. still much hotter at the poles;
- the release of methane from the permafrost and the frozen ice at the North pole will bring temperature rise to + 10 degrees Celsius;
- the COP21 policy is too slow and uncertain.

Let us explore below whether the key countries are moving or planning to move in this decarbonisation direction? Each single country has its energy consumption pattern that must be taken into account in both domestic and international energy supply transformation.

Energy in a wide sence

I suggest we analyse energy in a wide sense. The need for energy is obvious in all the human sources of GHGs – see Figure 1.

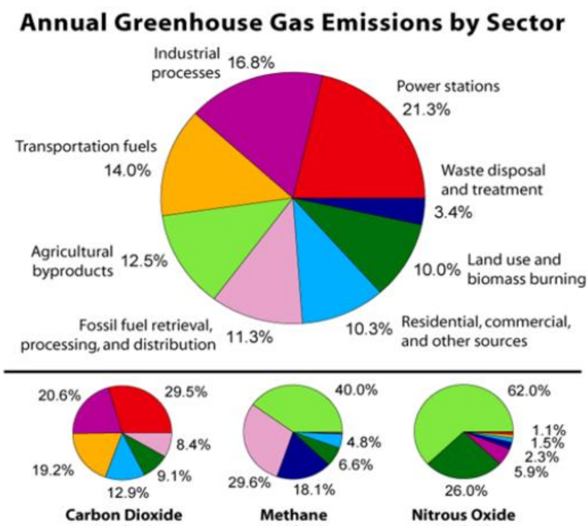


Figure 1. Human sources of GHGs, globally

What Figure 1 shows is that the GHGs stem from all vital sectors of society, not merely energy production itself. Energy is the capacity to do work. And work is the source of human welfare. The growth in energy consumption since the industrial revolution and especially after the Second World War has been just immense, especially the supply of fossil fuels. In poor countries, the demand for energy is huge for economic development, whereas rich countries are heavily dependent of fossil fuels for economic growth.

The majority of countries in the COP project are in poverty, as they need more energy. Thus, they can only decarbonise when renewable energy sources become available. This is the redistribution task of C0P21.

Energy and its human consequences

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.

For instance, African countries are poor because they have too little energy. Thus, they have much less GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydro power depends upon water availability that shrinks with global warming.

African energy deficit is conducive to a dire environment with enormous damages and risks. Consider the following global figures. Figure 2 shows how low energy leads to am unsafe environmental.

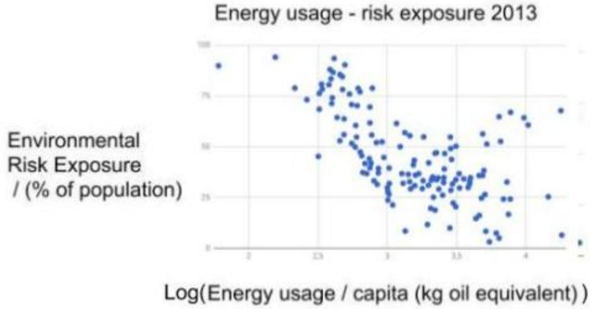


Figure 2. *Energy and environmental risk exposure*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

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 3 has the global picture.

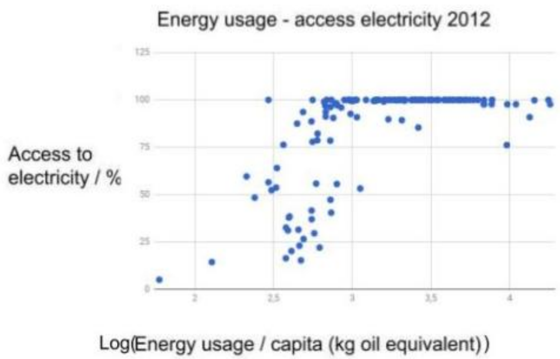


Figure 3. *Energy and electricity Access*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 4 links energy with proper sanitation.

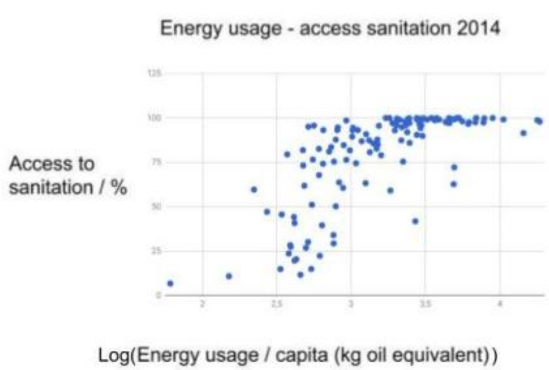


Figure 4. Sanitation and energy
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Especially, the rapidly growing African, Latn American and Asian mega-cities lack entirely proper 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 4 links energy with proper sanitation

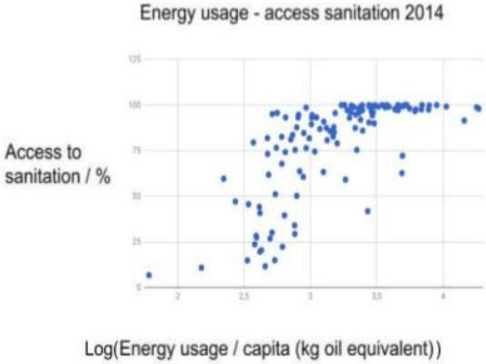


Figure 4. *Sanitation and energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Figure 5 underscores the necessity of more energy in poor coutries for prper sanitation, without which the life of humans is "*salle*".

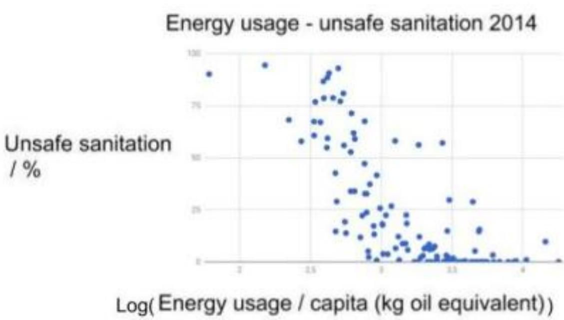


Figure 5. *Energy and unsafe sanitation*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Air quality too depends upon energy access (Figure 6).

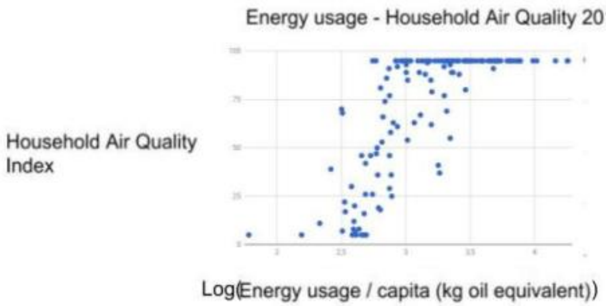


Figure 6. *Energy and air quality*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

Typical of many poor nations – Latin America, Africa, Asia - is the lack of predictable access to safe electricity, which hampers work and reduces environmental viability. The access to safe electricity is, it must be emphasized, absolutely central for health, schools, food, potaable 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!

If, as we believe, energy consumption is behind global warming, the set of poor countries face a most difficult dilemma. On the one hand, they can demand much more energy like fossil fuels, but they then contribute much to climate change, On the other hand, global warming while fabricated by the rich nations and a few very populous poor nations, will have very negative consequences for poor nations. The only way out of this dilemma is that all countries contribute to halting global warming by turning to renewables, especially the set of rich countries.

Thus, energy consumption is closely related to country affluence. The poor countries can only improve living condition by increase energy supply. Their energy demand can only go up, because energy supply is highly skewed to the advantage of the rich countries – see Figure 7.

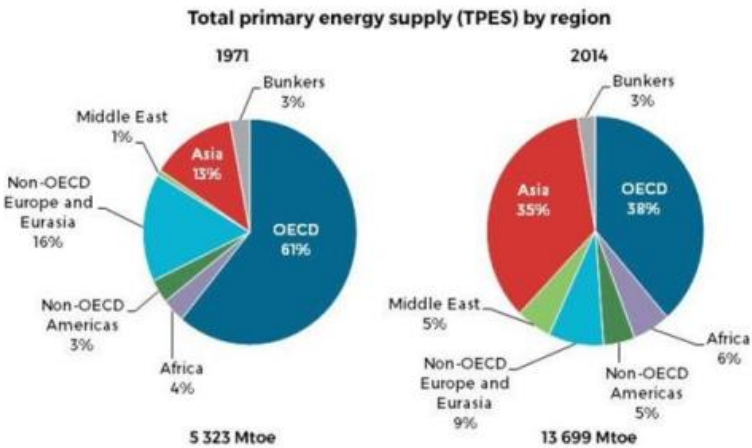


Figure 7. *Global Energy Consumption*
Source: [Retrieved from].

Poor countries need much more energy, but of a new kind. They need assistance to move to modern renewables, as they will give up fossil fuel only if there is compensation by other new energy sources. It must be underlined that GHG emissions like CO2s are a function of GDP and population. Only very big poor countries have huge GHG emissions, like India, Brazil and Indonesia. Small poor nations have little GHGs, as they lack energy in great quantity. Yet, poor countries wish to participate in saving the planet from the dangers of climate change on the condition of financial assistance from the COP project and its Super Fund.

In terms of GHGs, rich countries have much higher levels of yearly emissions compared with poor countries, holding population constant. Only when a poor nation is huge, doe it have enormous CO2S.. Strict linear relation hold between

GDP, energy consumption and GHGs, both on a per capita basis and on an aggregate country level. I will only show one Figure to show this – Figure 8.

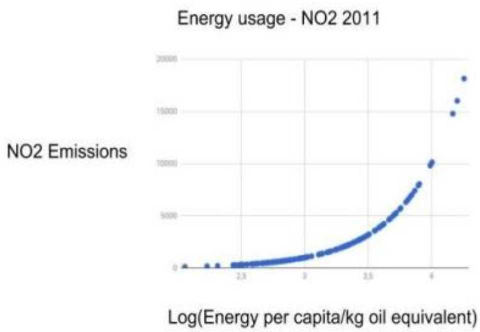


Figure 8. *Nitrous oxide and energy*
Source: Environmental Performance Index, Yale University, [Retrieved from]. IEA Statistics © OECD/IEA 2014. [Retrieved from].

While the UNFCCC has mainly concentrated upon the CO2s, the GHGs comprise several gases, on of which is the nitrogen oxide. Production of nitrous oxide stems from microbial activity in soils and in the ocean. Human sources of nitrous oxide are combustion of fossil fuels, biomass burning, industrial production of nitric acid, and fertilizers. Nitrous oxide enhances the greenhouse effect just as carbon dioxide does by capturing reradiated infrared radiation from the Earth's surface and subsequently warming the troposphere. It stays in the troposphere for about 120 years before moving into the stratosphere where it is conducive to the destruction of stratospheric ozone.

Country management – A few examples

India

In Indian energy policies, it is emphasized that developmental goals take precedence over climate change considerations. Thus, all Indian household must have access to electricity and only sustained rapid economic growth can reduce poverty. India has a "take-off" economy that delivers affluence for the first time since independence. But it is based on fosil fuels. India looks into other sources of energy, as long as socio-economic development is not hindered. Figure 8 shows the main features of future planning.

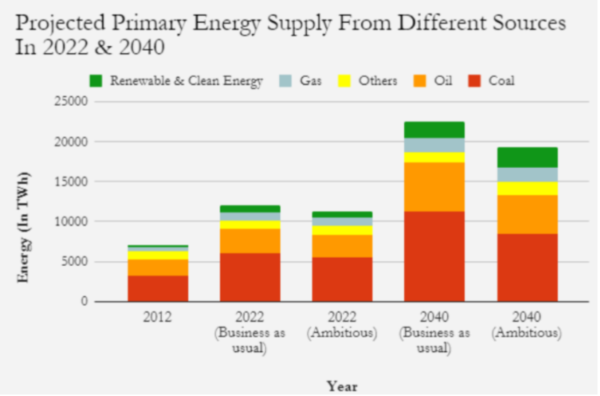


Figure 8. *India`s energy future*
Source: [Retrieved from].

India has rapidly become a major CO2 emitter due to its high growth rates since 1990. It uses lots of coal, stone or wood. Charcoal is bad for households and results in forest destruction. India tries to broaden its energy supply to modern renewables, like solar, wind and hydro power. Yet, it will remain stuck with fossil fuels for decades. It needs assistance from the COP21 project, especially for solar power parks. Building more dams is very risky, as global warming reduces water assets. Figure X indicates the India cannot meet its COP21 promises.

Brazil

Brazil is a "catch-up" with its "take-off" point long ago in the 20th century.. Compared with India, but it never really succeeds to close the gap to North America, tumbling now and then into dictatorship or recession. Figure Y shows its stylised energy plans – are they in agreement with COP21 hopes of decarbonisaton?

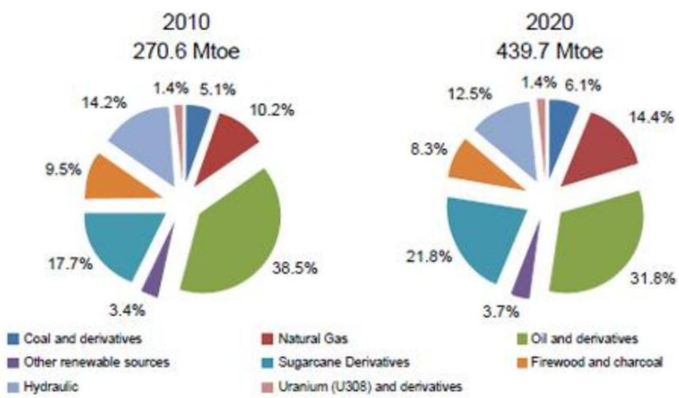
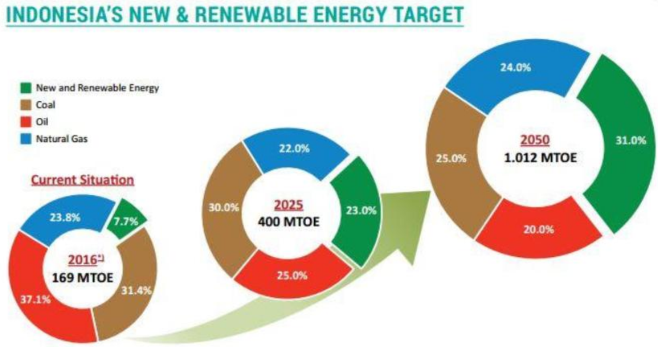


Figure 9. *Energy plans in Brazil*
Source: [Retrieved from].

Brazil has already a diversified supply of energy. However, since the country plans to almost double its energy supply, its dependence upon fossil fuel will grow, also upon coal. It dreams about building many more dams in the Amazons, but future water shortages due to climate change may make these plans unrealistic. The country needs COP21 assistance to turn to solar power massively, in order to eliminate first and foremost coal and charcoal. The rain forest is part of Brazil' s emission picture where burning and logging reduce its carbon uptake.

Indonesia

Indonesia is like India a "take-off" country, enjoying rapid economic growth with attending augmentation in energy consumption. The outcome is that this giant nation has quickly become a major GHG emitter. What make the situation worse is the burning down of the rain forest in parts of Indonesia.



	2016	2025	2050
NRE Mix	7.7 %	23%	31%
Energy Supply	169 MTOE	400 MTOE	1.012 MTOE
Generation Capacity	59 GW (NRE 8 GW)	136 GW (NRE > 45 GW)	443 GW (NRE > 167 GW)
Electricity/Capita	956 kWh	2.500 kWh	7.000 kWh
Electrification Rate	91%	~100%	~100%

Figure 10. *Energy future for Indonesia*

Indonesia`s energy augmentation plan is way beyond global decarnnisation plans.

USA

The US has reduced its CO2 emissions during the lats years, mainly by a shift to natural gas. Actually, several mature economies have been able to halt the rise of CO2 emissions, either by more energy efficiency or a shift to natural gas or renewables. Figure 11 captures some features in US energy plans.

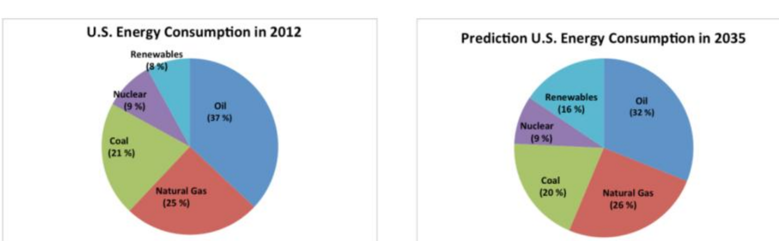


Figure 11. *US energy future*
Source: [Retrieved from].

Although the Figure 12 predicts a doubling of renewable energy, the dependency upon fossil fuels, including coal energy, will not bee much reduced. We are talking here about relative numbers, but if the US increases total amount of energy supply, then there may even be more fossil fuels. The reduction in CO2s during recent years seems to be coming at a reduced rate. The hope is for economic growth without energy increases, but we are not there yet. And most countries demand more energy for the future.

China

China now enters the First World, as it has long passed its “take-off” point in time around 1980 and has pursued a successful “catch-up” policy for a few decades. Its energy consumption, especially fossil fuels, has skyrocketed with GDP, resulting in the largest CO2 emission globally. Figure 12 has a projection for China.

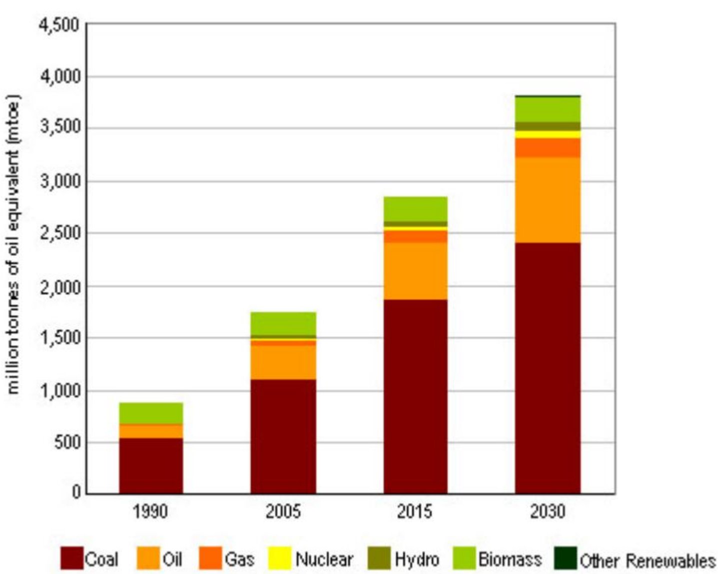


Figure 12. *Energy projection for China*
Source: [Retrieved from].

Decarbonisation does not seem highly probable. Much hope was placed at a recent reduction in CO2s, but water shortages forced China to revert to coal in 2017 with attending augmentation of CO2s. China is investing in both renewables and atomic power, but it also plans for large energy increase in the coming decades with lots of energy consuming new projects.

Policy response to abrupt climate change

As the potentially huge methane emissions enter the climate change debate, one fully understands the mounting pessimism. And the entire time scale for fighting global warming shrnks considerably, from 100 years to 50 years or even less.

Yet, only improved COP21 policy-making could help. The Keeling must be stabilised as soon as possible, having reached 412 recently. The release of methane depends upon that. Thus, one may outline a more radical COP21 policy and ask for its implementation to start now:

1) Close down of all coal power plants in 2020; replacement of charcoal in poor countries by mini gas stoves;

2) Massive investments in solar power parks – see below; subsidies for solar installations in private homes;

3) Accelerated experiments with carbon capture to find accurate cost benefit calculation for all forms of geoenginering.

Here comes the solar power revolution that will allow a massive reduction in fosil fuels. Let us see what it entails in terms of management tasks for global coordination, assisted by for instance the COP21 Secretariat and the IPCC.

Table 1. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: Global scene (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/%of2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
United States	26 – 28[2]	2.100	3.200
China	None[3]	0	3.300
EU28	41 – 42	2.300	2.300
India	None	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Canada	30	230	300
Mexico	25	120	200
Australia	26 – 28	130	190
Russia	None[4]	0	940
World	N/A	N/A	16.000

Source: UN Framework Convention on Climate Change: CO2 Emission Reduction With Solar. [Retrieved from].

Notes: 1) The United Sates has pulled out of the deal; 2) The United States of America made this pledge but has subsequently withdrawn from the agreement; 3) No absolute target; 4) Pledge is above current level, no reduction.

It will of course be argued against such a 40 per cent speedy reuction in CO2s that it leads to economic recession. So may it be! But it would reduce future much higher costs. After all, economies adapt and will recover due to all new investments needed in a decarbonised world.

Ramesh (2015) emphasizes that India needs much eonomic assistance for decarbonisation – a giant task for global coordination to assist poor nations!

Let us look at the American scene in Table 2.

Table 2. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: American scene (Note: Average of 250 – 300 days of sunshine per year was used for Canada, 300 – 350 for the others).*

Nation	CO2 reduction pledge/% of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Canada	30	230	300
Mexico	25	120	200
Argentina	None[3]	0	80
Peru	None[3]	0	15
Uruguay	None[3]	0	3
Chile	35	25	30

Note: [3] No absolute target.

Some Latin American countries have lots of hydro power, but it may dwindle rapidly due to abrupt climate change. Solar power would be excellent energy for Mexico and Brazil for example.

Table 3 has the data for the African scene with a few key countries, poor or medium income.

Table 3. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: African scene (Note: Average of 300 – 350 days of sunshine per year was used).*

Nation	CO2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Algeria	7 – 22[5]	8	50
Egypt	None[3]	0	80
Senegal	5 – 21	0,3	3
Ivory Coast	28 – 36[5]	2	3
Ghana	15 – 45[5]	1	3
Angola	35 – 50[5]	6	7
Kenya	30	3	4
Botswana	17	1	2
Zambia	25 – 47[5]	0,7	1
South Africa	None[3]	0	190

Notes: [3] No absolute target.; [5] Upper limit dependent on receiving financial support.

Table 4. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II. Asian scene (Note: Average of 250 – 300 days of sunshine was used for Kazakhstan, 300 – 350 days of sunshine per year for the others).*

Nation	CO2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Saudi Arabia	None[3]	0	150
Iran	4 – 12[5]	22	220
Kazakhstan	None[3]	0	100
Turkey	21	60	120
Thailand	20 – 25[5]	50	110
Malaysia	None[3]	0	80
Pakistan	None2	0	60
Bangladesh	3,45	2	18

Notes: [3] No absolute target; [5] Upper limit dependent on receiving financial support.

Given the economic advances in Asia, most countries need a lot of solar power parks for decarbonisation. The COP21 management would be able to help. Finally, we come to the European scene.

Table 5. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: European scene (Note: Average of 250 – 300 days of sunshine per year was used)*

Nation	CO2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40% reduction
Germany	49[6]	550	450
France	37[6]	210	220
Italy	35[6]	230	270
Sweden	42[6]	30	30

Note: [6] EU joint pledge of 40% compared to 1990.

The turn to renewables in Europe occur at the same time as atomic power stations are going to be closed, at least in some countries. This makes solar power plants even more relevant, a coal power must be abolished, rather sooner than later.

Conclusion

Time has come for halting and reducing CO2 emissions by real implementation and not utopian dreams of a sustainable economy (Sachs, 2015). There is nothing to wait for any longer (Stern, 2015), as the COP23 must set up the promised Super Fund. No time for politicking in the UN any longer (Conca, 2015; Vogler, 2016).

It must be underlined that the ultimate responsibility rests will the state and their governments (Stern, 2007). There is no one single policy approach that "*WE*" must take. Each government has to present its plans and specific situation to a Cop21 managing board, in collaboration with markets and financial institutions.

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10 Global warming and the G22 nations: On the failure of the unfccc and chaos theory

Introduction

The global governance of climate change issues has been entrusted the UN and its bodies, like the UNFCCC and the IPCC . This has been conducive to the mixing of global warming with the ideas of sustainable development. engaging all UN member states. I will argue that this is extremely unfortunate, as the UN bodies dealing with the issues are simple too big – transaction costs heavy. And global warming policy should be conducted by the countries that are mainly responsible, namely the G20 nations.

Moreover, the various sustainable development goals mention climate change as one of them, but for mankind it is of overwhelming importance. The concrete COP21 Treaty objectives do not at all mention al there developmental goals of sustainability, but centers upon global de-carbonisation. Only the G20 nations can achieve that, because they are responsible for almost 80 per cent of the greenhouse gases (GHG).

Decarbonisation goals and sustainable development

The G20 nations almost perfectly coincide with the list of heaviest GHG or CO2 polluters. One needs to add Iran and delete Argentina. Among the largest polluters, we find international air traffic and international shipping, on the increase year in and year out, especially air traffic.

The global de-carbonisation plan according to the COP21 Agreement from Paris 2015 sets out a set of three stages and one mechanism to promote renewables or atomic power. Thus, we have:

1) Halting the CO2 increases in all countries by 2020 (GOAL I);

2) Reducing the CO2s by some 30 per cent by 2030 or more (GOAL II);

3) Achieve 75 per cent CO2 reductions by around 2080 (GOAL III);

4) Setting up of a Super Fund – 100 billion $/year – to assist countries in energy transformation away from fosil fuels.

These four elements – objectives and mechanism - above make for a realistic plan for global de-carbonisation in the 21st century, saving mankind from Hawking irreversibility. But is it really implementable, given the typically egoistic incentives of countries and their governments? And what is the set of management strategies to be employed with the Super Fund. Not much progress has been accomplished by the UNFCCC since the Paris Treaty as far as implementation is concerned, although a few giant solar power parks have been constructed.

The UN Sustainable Development Goals are almost entirely different, with only (13), (14) and (15) being related to (7), *clean energy*.

Source: UNDP.

These goals are NOT realistic, especially as humanity keeps increasing. We know of no socio-economic system that can accomplish these objectives.

In the global warming discussion, there has been a tendency to conflate sustainable development with climate change (Sachs, 2015), in an effort to "fix" everything in one set of global UN policies: climate, justice, poverty, etc. This is very unfortunate, because it is merely utopian.

Climate change should be counter-acted by specific policies related to energy demand and supply by the main GHG polluters of the planet Earth, namely the G20 nations. This group can handle transaction costs, which the UN cannot.

Implementation of energy policy: Wildavsky's Hiatus

Basically, the global warming problematic is one issue, namely the anthropogenic sources of GHGs, stemming from energy consumption in a wide sense in all areas of human activity and social systems, from households over transportation to industry and agriculture. The energy-emission conundrum concerns the use of energy for generating affluence with attending emissions of CO2s, methane, etc.

Burning fossil fuels is today essential for affluence and wealth, being vital to poor and rich countries. If energy consumption is reduced, economic recession and mass poverty would follow rapidly as well as of course also unemployment writ large social unrest. Planet Earth consumes simply far too much energy from burning the fossil fuels– see Table 1.

Table 1. *Energy 2015 (Consumption in Million Tons of oil equivalent)*

	Total	%
Fossil fuels	11306,4	86,0
Oil	4331,3	32,9
Natural Gas	3135,2	23,8
Coal	3839,9	29,2
Renewables	1257,8	9,6
Hydroelectric	892,9	6,8
Others	364,9	2,8
Nuclear power	583,1	4,4
Total	13 147,3	100,0

Source: BP Statistical Review of World Energy 2016

The hope that the augmentation of CO2s would “stall” has been nurtured widely, but now China reports ominously that its CO2s are set to increase again for a few years. Thus, Figure 1 may lead to the planet not fulfilling even COP21 GOAL I in 2020.

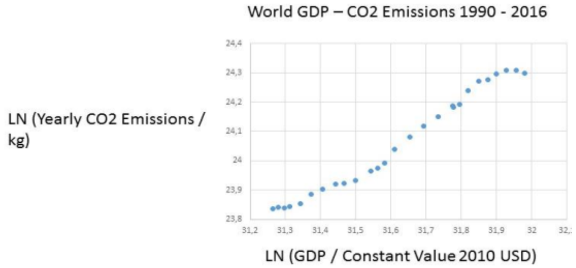

Figure 1. *GDP-CO2s 1990-2016*

GDP increases with the augmentation of energy per capita. 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 can this promise be kept or fulfilled? Figure 2 shows the almost iron law type link.

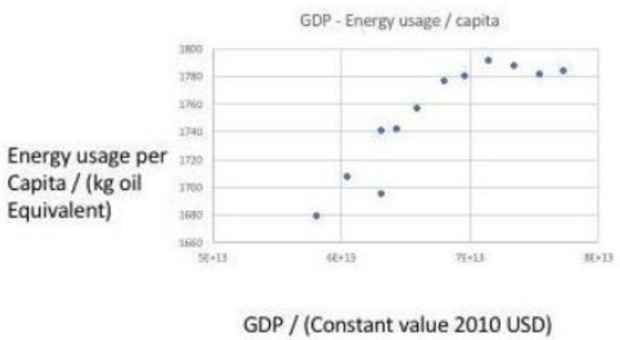

Figure 2. *GDP against energy per person, 2005-2016*

Given the fact that the global economy depends to almost 90 per cent upon fossil fuel energy, as well as plans for another 20-30 per cent augmentation in energy demand for the next 30 years, the conclusion is that energy transformation is of utmost urgency, Global governance has fixed the objectives – GOAL I, II and III – but knows not how to implement them.

Enter Wildavsky: Although it was well-known in public administration and policy analysis that government policy-making could be flawed, incoherent and even erroneous in its empirical assumptions, it was a small chock when Wildavsky came along saying that policies often fail in the implementation stage. It is what happens AFTER the key decisions on policy that matters most for policy success or failure (Pressman & Wildavsky, 1984). Very often, policy execution fails to achieve the objectives. Policies may turn out to be counter-productive, promoting entirely different or opposite goals.

The COP21 process has yet to begin policy implementation. And the great danger is defection by the members of this Agreement on a gigantic CPR – common pool regime. Reneging in this Ocean PD game may concern contribution to the Super Fund or inability or unwillingness to fulfill the COP21 obligations: GOAL I, II and III.

GHGs, methane emission and chaos theory

There are several types of GHGs, but the UNFCCC has concentrated upon the carbon dioxide particles (CO2s). They are considered responsible for the human induced temperature rise that is global warming. It is true that the CO2s constitute the largest part of the GHCs.

But halting the increase in CO2s is far from enough to halt global warming. As long as the countries in the world have large positive outflows of CO2s, the risks of climate change augment. Methane emissions are now becoming more frequent and important for global warming. Thus, we have several greenhouse gases, but the two biggest are the CO2s and methane. Finally, we have the Nitrous Oxide (fertilizers) and very small amounts of F-gases. Methane and F-gases are more powerful in preventing sun radiation to exit the Planet, but they are not as long lasting as the CO2s. The oceans swallow much CO2s, but this leads to acidification. Air conditioning uses F-gases – a positive feedback loop. Methane emissions will increase significantly in the next decades, as the permafrost melts. Below is Florent Dieterlen's calculation of the rise of methane emissions in Figure 3 (see papers by Lane & Dieterlen 2017).

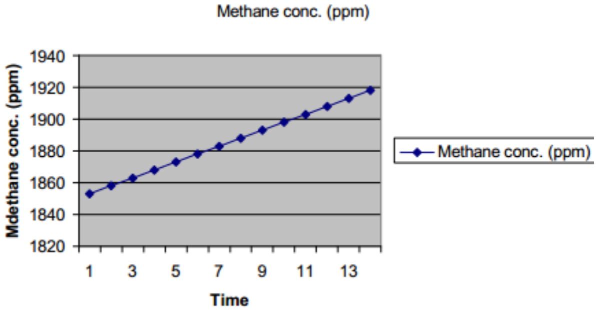

Figure 3. *Methane emissions in Dieterlen's projection*

With methane emissions rising, it is all the more urgent to considerably reduce CO2 emissions. Can all nations do it? Any decrease in methane concentration is improbable, due to: Agriculture emissions, as the temperature increase the metabolism of microbes in rice agriculture; Wetlands emissions do not diminish with the microbial chemical activity on increase; Fossil fuel production especially LGN; Forests diminish in the tropics, resulting in a decrease in animal or vegetal resources; Melting permafrost releases methane from land and see.

Globalwarm9ing will turn into *chaos* at the Hawking irreversible point in time, because we will have to face:

1) sharp temperature variations at various locations on planet Earth, like the North and South poles,

2) grave sudden impacts, like permafrost melting releasing methane,

3) powerful positive feedback lopes, like methane emissions augmenting the speed of temperature rise, which in turn melts more ice, making for ocean acidification, and huge land losses,

4) with all resulting in jumps in the Keeling curve.

We need to develop *chaos modelling* of how global warming impacts upon storms and wild fires, as well as dramatic increases in sea level rises in certain areas, like e.g. the Pacific Ocean region.

Implementation difficulties

It is to be emphasized that global warming policy-making and policy implementation is about energy transformation – de-carbonisation. It is not about global justice, income or wealth re-distribution, as well as poverty alleviation. Money from the Super Fund may certainly be employed for such purposes, sustainable development goals or even compensation for the ills of colonialism. If so, the UNFCCC will fail.

One may also underline that climate change policies do not generally address environmental problems like "*plasticization*" of oceans and sees, reduction in endangered species or species loss.

The whole thing about halting global warming is to replace fossil fuels with modern renewables and nuclear power. Can the G20 nations do this according to the COP21 Treaty?

Asian Great Miracles

The fate of global de-carbonisation hinges upon policy implementation in three giant Asian countries, all committed to catch-up strategies of quick socio-economic development, using energy. They are China, India and Indonesia.

China

Very recent information says that China, the biggest emitter of CO2s, will not succeed to halt its curve for CO2s. Instead, it counts upon some 3 per cent increases the nearest years – see Figure 4.

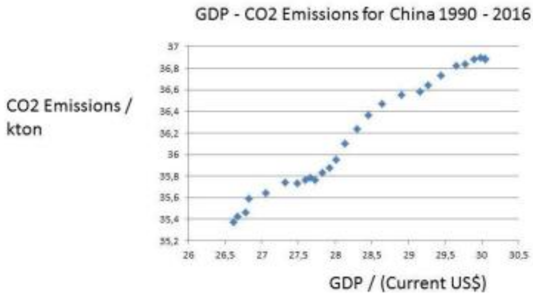

Figure 4. *China: GDP and CO2s: y = 0,46x, R^2 = 0,98*

China has officially declared that it intends to meet both COAL I, halting the increase in CO2s, and GOAL II, reducing CO2s by some 30 per cent. But promises and intensions are one thing, real life developments another matter. All countries in this CPR can at any time renege, the US has already done. If China too defects, then we have Hawking irreversibility.

China promises to reduce is GHGs, especially the lethal pollution in Beijing. But it also has great plans for future energy demands! It is true that China moves aggressively into new power sources: solar, wind and atomic power. But its ambitions for air traffic, car markets and the New Silk Road are daunting.

India

The upward sloping GDO-CO2 curve is strong for India. And India will not accept a trade-off between growth and CO2s, putting the emphasis upon electrification of all households and poverty uplifting. Can and will India honour its de-carbonisation promises without generous Super Fund help?! Look at the present pattern of energy consumption (Figure 5).

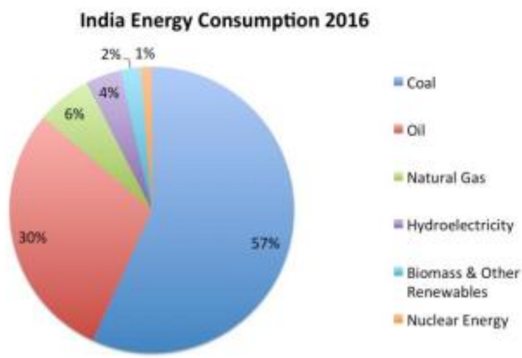

Figure 5. *India*

Fossil fuels, especially coal, dominate totally. In India, biomass is charcoal, more polluting than coal itself. India is completely out of tune with the COP21 objectives. The Indian government engages much in energy planning with foreign expertise – see Indian Energy Outlook from 2015 by IEA. One scenario is portrayed in Figure 6.

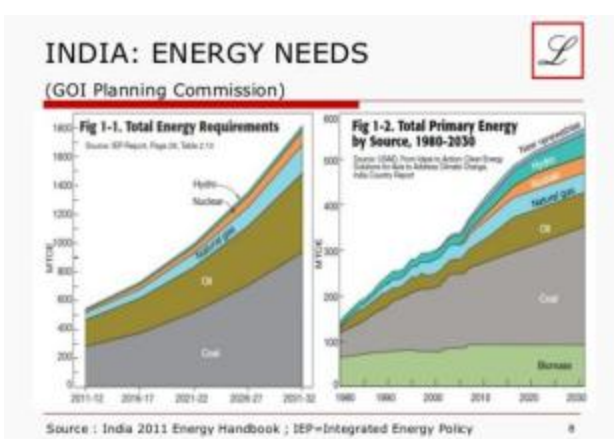

Figure 5 *India*
Source: [Retrieved from].

The huge planned expansion in energy demand is not in agreement with global de-carbonisation plans. To reduce coal and charcoal dependency, India must turn to atomic and solar power. Hydro power requires safe access to water, which global warming may undo for Himalaya.

Indonesia

Indonesia, being a giant nation with economic growth and enormous forest burning, displays a strong upward trend in CO2s.What makes Indonesia so important for the implementation of global de-carbonisation according to the COP21 Treaty is not only is mega size in population, but also its rain forests in Kalimantan and Sumatra. The government has not been able to protect these global lungs, as they are cut down and burned for agriculture. It is true that renewables are planned to increase, but so is coal. Together with forest emissions, Indonesia has to renege, as the planning of the expansion of the energy sector – Figure 7 – shows little regard for COP21 objectives.

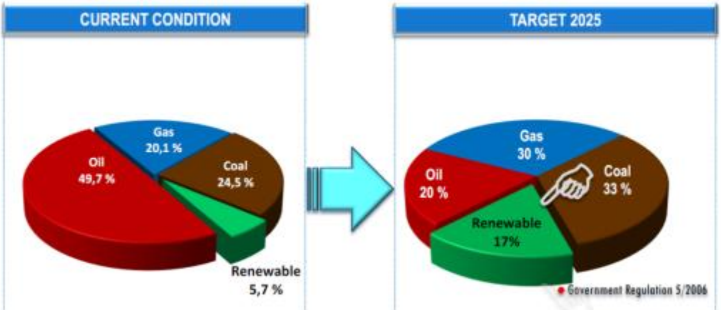

Figure 7. *Indonesian energy mix*
Source: [Retrieved from].

Ausralia's Intransigence

Australia has always been negative to global de-carbonisaion, a least according to the prevailing attitude among its leading politicians. This stance reflects the country's total reliance on fossil fuels at home for energy, as well as its giant exports of fossil fuels to other countries, especially in the Asia-Pacific region. Australia is perhaps one of the most addicted to fossil fuels country in the world. However, its GDP-CO2 curve has recently stalled. The energy mix is presented in Figure 8.

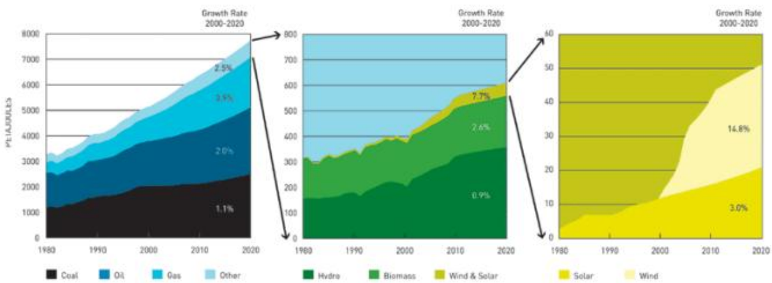

Figure 8. *Energy plans for Australia*
Source: [Retrieved from].

Without a consistent policy reversal, Australia may be forced to renege upon de-carbonisation. "Our future lies in keeping increasing living standards", says PM Turnball, but more important for mankind is a stable atmosphere, generally speaking. With the planning in Figure 8, Australia will not comply with COP21.

The Americas and Us Defection

One may focus the interest in the Americas upon other big G20 nations than the US. But it may be said that the US now has a declining CO2 curve due to reduction in coal and increase in gas. It will fulfill GOAL I, but hardly GOAL II without policy changes/ In all the four giant nations – USA, Canada, Mexico and Brazil – the increases in CO2s have stalled. There is a slight decrease in GHGs, but methane emissions are increasing. Coal consumption is down and a variety of modern renewables have been put in place. All four would fulfill GOAL I in the COP21, but they are going to fail GOAL II. Each of these big nations has an Achilles heel when it comes to de-carbonisation.

US = Fracking

When it is projected that the US will be a major exported of oil and gas around 2050, the source is fracking. It is already a considerable source of natural gas, helping to reduce coal consumption. But fracking is still carbonization, with increases in methane emissions. Figure 9 shows that the US will rely more upon natural gas than on renewables,

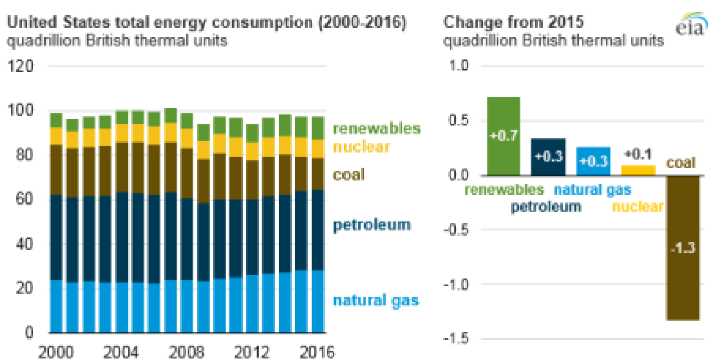

Figure 9. *US energy mix*
Source: [Retrieved from].

Canada = Oil Sands

Canada enjoys massive amounts of hydro power, which will last as long global warming does not result in water shortages. It also invests heavily in wind power. But its great dependence on oil sands is not conducive to de-carbonisaion. The oil sand business is very dirty, polluting and expansive with pipeline to the US. Figure 10 would not pass GOAL II.

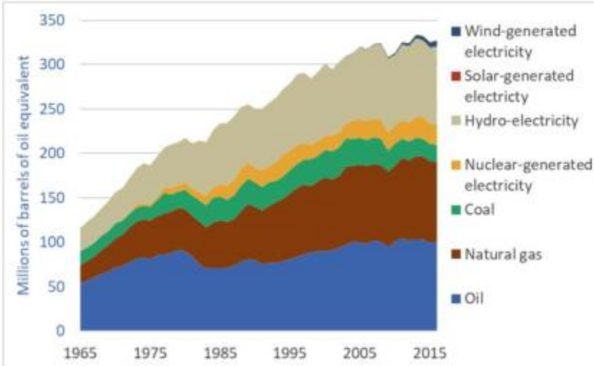

Figure 10. *Canada energy mix*
Source: [Retrieved from].

Brazil = Energy expansion and Amazons?

Brazil enjoys the benefit of access to various energy sources. At the same time it has a huge population with lots of poverty. This implies that socio-economic development has the greatest priority with Brazilian politicians. The outcome is the plan for a phenomenal increase in energy demand – see Figure 11.

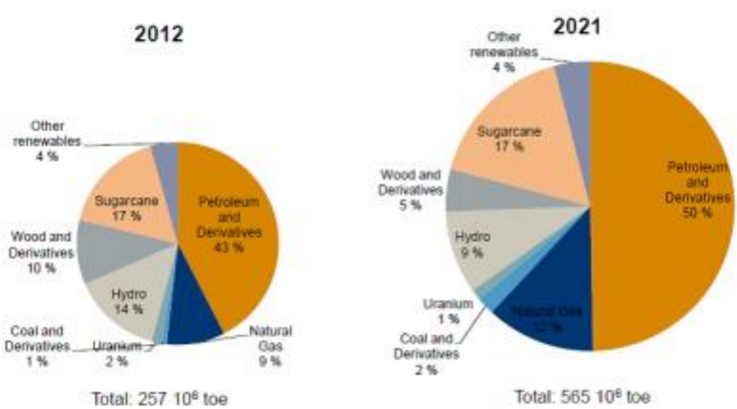

Figure 11. *Brazil energy mix*
Source: [Retrieved from].

This is more than doubling of energy supply, confirming how important energy is for affluence. The key question is whether Brazil will turn a rapidly shrinking y of dams instead of putting the resources into solar power parks?

Mexico= oil and gas!

Here we have a typically carbonized country. Figure 12 shows that fossil fuels today account for around 90 per cent of energy consumption.

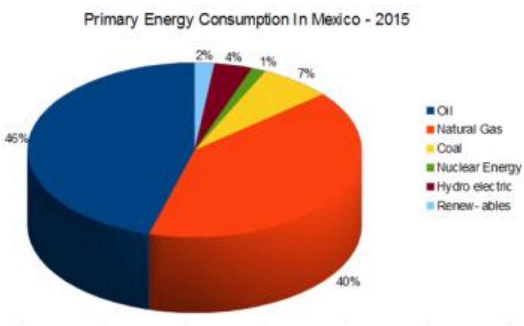

Figure 12. *Mexico energy mix*
Source: [Retrieved from].

It is true that Mexican planning speaks much of renewables, but the distance to GOAL II is distant indees. Again, solar power would help Mexico de-carbonise.

Middle East Oil and Gas

In this region of the world, one set of countries possess enormous oil and gas reserves, and they are often very rich, if well-ordered societies. Another set of countries have to import fossil fuels. The Middle East is carbonized to nearly 100 per cent. And none of them could fulfill GOAL I AND GOAL II. See Saudi Arabia's CO2sincrease in Figure 13.

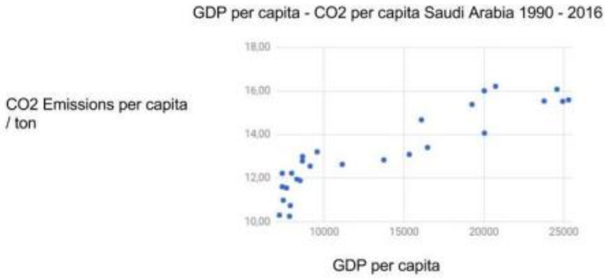

Figure 13. *Saudi Arable GDP-CO2s*

Saudi Arabia only uses oil and gas. And why not? Yet, as partners in the COP21 club with its CPR of de-carbonisation, also the Saudis must change. To fulfil GOAL I and II, the new Saudi ruler has outlines an ambitious transformation plan, involving the turn to renewables and atomic power. It also involves the construction of cities, entirely energized by non-fossil energy sources. The Saudis can pay for all these magnificent plans, but global warming may make life in the Gulf difficult to support, as temperature rises and air conditioning fuels climate change.

The highest per capita CO2 emissions in the world are to be found in the Gulf, with UAE and Qatar. They have a life-style based on enormous energy consumption and pharaonic cement constructions. They say they want to de-carbonise too – solar power!

But these Gulf plans are hardly credible. Iran has been a sleeping giant for decades due to political and religious turmoil. It nourishes its large and fast growing population with oil and gas energy. To CO2 augmentation, it must turn to COP21 and follow its de-earbonisation plan: GOAL I and II.

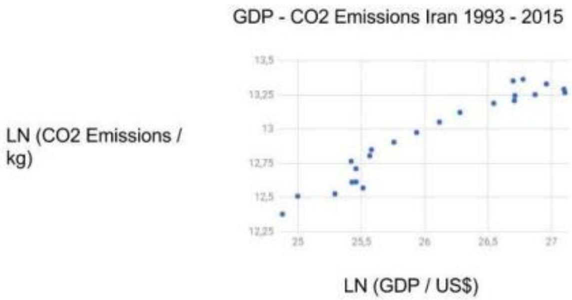

Figure 14. *Iran GDP-CO2s*

Coming out of isolation and representing Shia power in the region, Iran must be paid attention to, both politically and economically; it has the capacity to de-carbonise, using nuclear and renewable energy. This would require though more of stability in this region.

European Hesitance

The EU has pushed for anti-climate change policy-making for a long time. Most EU countries now have falling CO2 curves, reflecting a diversified energy supply – see Figure 15.

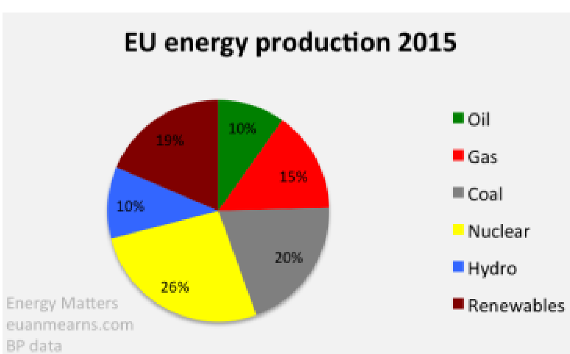

Figure 15. *EU energy mix*

However, the energy mix in various EU member states is highly different, as some rely much upon coal still. France has more than any country favoured atomic. Coal is burned in Eastern Europe and Germany. Natural gas is used in many countries, with imports from Russia and Algeria. What is stunning in the EU energy policies is the plan to remove all coal and all nuclear power – see Figure16.

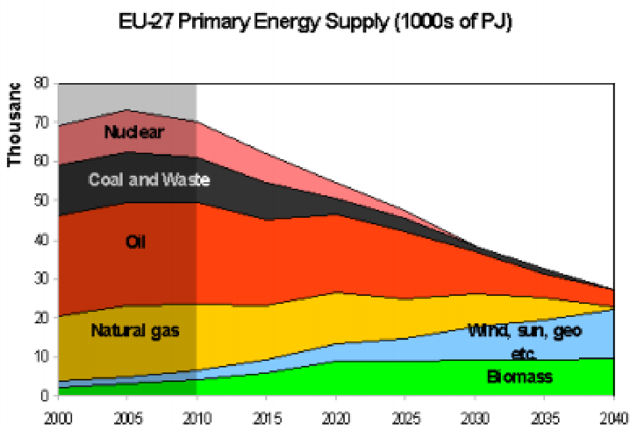

Figure 16. *EU plans for de-carbonisation*
Source: [Retrieved from].

But where is the supplementary energy going to come from? All energy from coal and atomic power must of course be replaced – HOW? Most nations count on retrieving more energy the coming decades, but not the EU according to Figure 16.

The Europeans have coupled de-carbonisation with the stop of atomic power, although these two energy kinds have nothing to do with each other. If halting climate change is the first priority because of urgency, then governments may use nuclear power, which also happens to be the case in several other countries. Global warming is more lethal than atomic power plants failure, especially if we pass Hawking irreversibility. Germany continues with coal (from Colombia!) but shuts down nuclear plants. France prefers to close nuclear plants ahead of updating them, making then safer. The question of final resting place for nuclear waste is most difficult, but climate change comes before in time.

Abolishing coal and dismantling atomic power, the European will have to build many solar power parks.

Solar power parks

The Wildavsky hiatus – how to begin implementing the COP21 Treaty? The closer in time to 2020 we come, the larger the risk becomes for country defections. GOAL 1 has to be fulfilled by 2020. And then comes the much more difficult GOAL II, with substantial de-carbonisation. Removing atomic power is NOT a solution to climate change, nor is carbon sequestration, as the Asian Development Bank suggests in 2013 and 2017. Solar power and electrical vehicles!

Table 2 estimates how many solar power parks of the Moroccan size are needed to replace the energy cut in fossil fuels and maintain the same energy amount, for G20 countries with the largest CO2 emissions?

Table 2. *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)*

G 20 Nations	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
United States	26 - 281	2100	3200
China	None 2	0	3300
South Korea	37	260	280
India	None	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Canada	30	230	300
Mexico	25	120	200
Australia	26 – 28	130	190
Russia	None 3	0	940
Canada	30	230	300

Mexico	25	120	200
Saudi Arabia	None ii	0	150
Iran	4 – 12iv	22	220
Argentina	None ii	0	80
Italy	351	230	270
Germany	4945	550	450
France	371	210	220
Turkey	21	60	120
South Africa			
World	N/A	N/A	16000

Conclusion

A realistic plan for halting global warming would include the following:

i) Focus first upon the G20 plus Iran;

ii) Close all coal plants up to 2020;

iii) Keep the existing nuclear power stations running;

iv) Start building solar power parks and wind power stations all over the world;

v) Turn then to the other countries – e.g. Chile, Paraguay, Egypt, Algeria Kenya, Pakistan, Thailand, Malaysia, Kazakhstan, etc. and help them close coal and charcoal down in order to concentrate upon solar power; Hand out small gas stoves to poor households in South Asia and Sub-Saharan Africa.

vi) Speed up the turn to electrical vehicles of all kinds.

vii) Build new atomic power plants with new safer technology;

viii) Use geo-thermal power extensively where possible;

ix) Maximise energy efficiency.

Global warming is so dangerous that it must the exclusive focus of he governments of the world, not to mix it up with UN development aims or general environmental concerns. The G20 groups of nations must go first in global de-carbonisation, closing all coal plants, replacing them with solar and atomic power, and start using electrical vehicles instead of SUVs.

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11 Energy and emissions on the African continent: Can and will the COP21 treaty be implemented?

Introduction

In the climate change process, the African countries suffer badly from the biggest externality in human history (Stern, 2007). They are not among the big emitters of greenhouse gases or CO2: s. But they have to adapt their societies and economies to temperature rise that will most probably go over + 2 degrees, and maybe even + 3 degrees. How to cope? If temperature rise goes even further towards + 4-6 degrees, life will be threatened. How can people work under too hot circumstances? Water? The wildlife?

Yet, African governments have promised to contribute towards the COP21 objectives of decarbonisation by transforming their energy systems. How to pay? Even if African nations carry out their responsibilities under the UN Treaty, there is no guarantee that the big emitters of CO2:s will not renege. And then we have the danger of the new methane emissions.

In this chapter, I will render a short overview of the energyemissions conundrum on the African continent. There is a basic catch-22: The African continent uses less energy per capita than the other global continents, which entails that total emissions of CO2s are lower than in Asia, America and Europe. Yet, Africa badly needs more energy, as it is the capacity to do work that result in income and wealth. If Africa could increase its energy share globally, it could reduce poverty. But this continent may contribute to global warming, resulting in great risks for its populations

Energy and emissions on continents

The countries on the African continent do not belong to the great polluters of CO2s in the world. Only a few of them have large CO2s like Egypt, Algeria, South Africa and Nigeria, but they do not rank among the really large 29 polluters in the world. This basic fact reflects their level of affluence, as energy and GDP are closely related. Consider Figure 1 with the global energy scene.

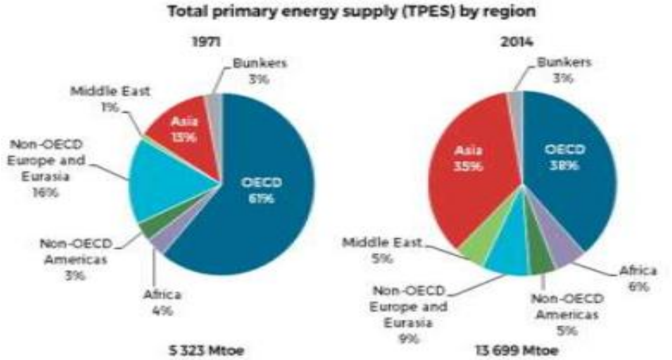

Figure 1. *Global energy*
Source: [Retrieved from].

It is small wonder that the African continent is the poorest, given its low share of global energy consumption.

The population of Africa is increasing fast, meaning that much more energy is needed for economic and social development, but the COP21 decarbonisation project must be respected!

African countries are unique in the sense that they do not contribute much to climate change, but they could stand to suffer enormously from global warming – the external effects of climate change. They range from excessive heat, constant need of air-conditioning (also augmenting emissions), droughts, ocean acidification, food shortages, and insupportable working conditions for peasants, etc. Yet, African governments can argue that they need much support for energy transformation, given the low share of global emissions for the continent – see Figure 2.

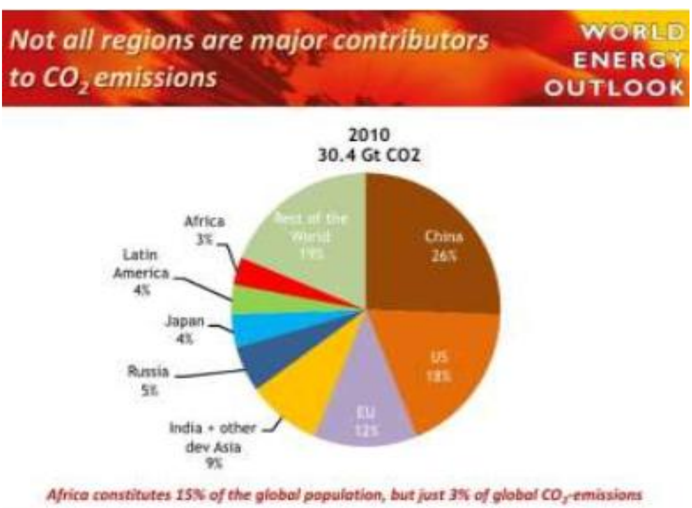

Figure 2. *Global emissions of CO2*
Source: [Retrieved from]

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 – see global Figure 3; but as energy consumption augments, so do emissions of GHG:s or CO2:s (Appendix 1). How to fundamentally transform global energy consumption?

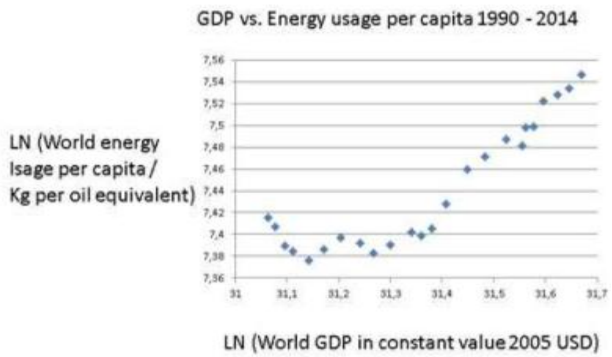

Figure 3. *GDP against energy per person (all countries)*

What is at stake for most people who understand the risks with climate change is not the *desirability* of decarbonisation in some form or another. They crux of the matter is *feasibility*: How to promote decarbonisation so that real life outcomes come about? 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),

will prove too demanding for most countries, I dare suggest also for African nations in dire need of the promised Super Fund.

GDP-energy-emission in Africa

African governments must now start energy-emissions policymaking within the framework of the UN Convention on Climate Change. Positively, they can argue that energy consumption is far too low on the African continent. The population is rapidly growing and needs massive electricity supply. Simple global energy-emissions fairness requires this.

Negatively, African nations are much dependent upon coal– wood coal except South Africa that uses stone coal – and oil and gas in the oil producing countries and Egypt. Most African countries employ wood coal and its derivatives, which maintain the continent in poverty. The COP21 project should be used by African governments for rapid electrification by means of NEW renewables. The energy-emissions conundrum applies also to the African continent, as CO2:s are rising, driven by economic development. The situation in 1990 for 13 major African countries was as depicted in Figure 4.

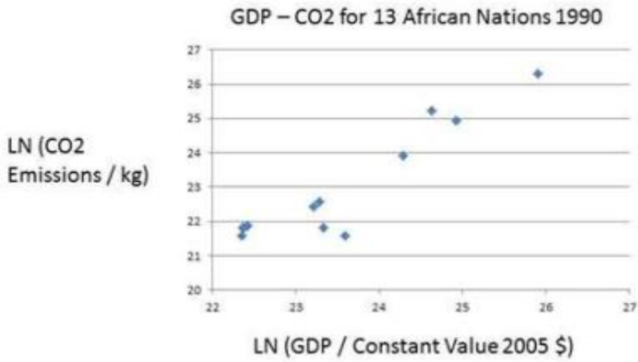

Figure 4. *GDP-CO2 link in 1990: y = 1,3354x; R^2 = 0,87*

20 years later, emissions have increased following economic development. Surely, the UN would be interested in seeing CO2:s low in Africa, but then it must help with a

fundamental energy transition from solids and fossil fuels to NEW renewables. (Figure 5).

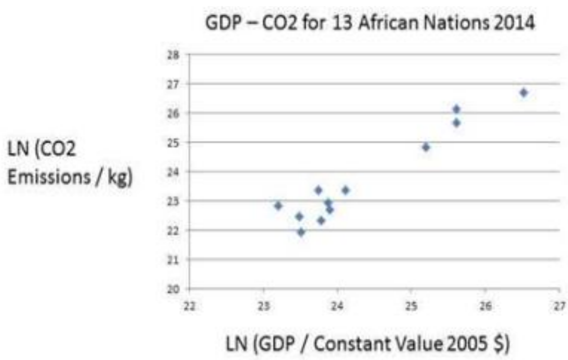

Figure 5. *GDP-CO2 link 2014: y = 1,4684x; R^2 = 0,93*

Solar power: Estimation of government' obligations

Let us first focus upon what this hoped for reduction of fosil fuels implies for the augmentation of renewable energy consumption, here solar power. The use of atomic power is highly contested, some countries closing reactors while others construct new and hopefully safer ones. I here bypass wind power and thermal power for the sake of simplicity in calculations.

Consider now Table 1, using the giant solar power station in Morocco as the benchmark – 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 data for the African scene with a few key countries, poor or medium income.

Table 1. *Number of Ouarzazate plants necessary in 2030 for COP21's GOAL II: African scene (Note: Average of 300 - 350 days of sunshine per year was used).*

Nation	CO2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Algeria	7 – 22[5]	8	50
Egypt	None[3]	0	80
Senegal	5 – 21	0,3	3
Ivory Coast	28 – 36[5]	2	3
Ghana	15 – 45[5]	1	3
Angola	35 – 50[5]	6	7
Kenya	30	3	4
Botswana	17	1	2
Zambia	25 – 47[5]	0,7	1
South Africa	None[3]	0	190

Since Africa is poor, it does not use much energy like fosil fuels, except Maghreb as well as Egypt plus much polluting South Africa, which countries must make the energy transition as quickly as possible. The rest of Africa uses either wood coal, leading to deforestation, or water power. They can increase solar power without problems when helped financially.

Let us show the relevance of the promised Super Fund of the UNFCCC to African nations. They need energy transformation according to COP21, but it cannot be done without the Super Fund.

African energy diversity

It cannot be more strongly underlined that energy patterns of consumption vary enormously on the African continent, which have clear policy implications. What has not been recognized is the several countries rely upon old renewables, which pollute. Below I make a short overview of the energyemission situation in a few major African countries, drawing upon official statistics and refraining from speaking about all the hopes and plan, yet to be fulfilled.

Coal Dependency: RSA

The RSA has a modern economy running on mainly coal. In transportation, it uses petroleum. This makes the RSA a major polluting nation. It wants to spread electricity to all shantitowns, but with what energy source? Figure 6 substantiates the basic point that economic development needs lots of energy all the time.

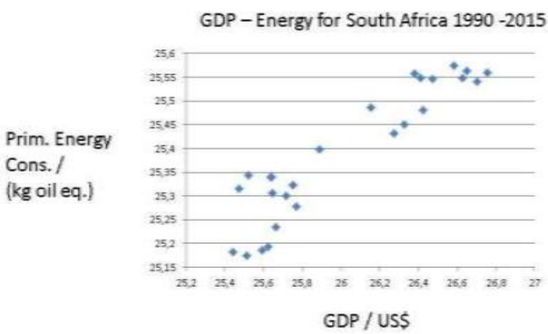

Figure 6. *GDP and energy in RSA : y = 0,2814x; R^2 = 0,8597*

As the RSA wishes to promote socio-economic development in the coming decades, it must increase the access to energy. High rates of economic growth are necessary for poverty reduction, which requires more energy. But energy consumption patterns in urban and rural sited in RSA are based on fossil fuels – see Figure 7.

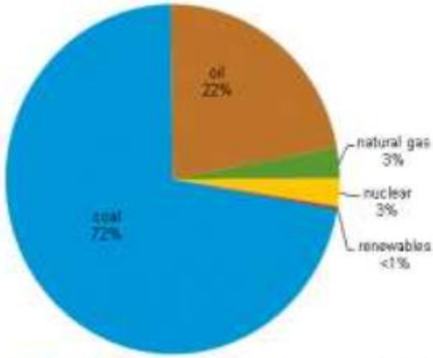

Figure 7. *Energy consumption in RSA*

The question is whether the present government with its weak economy has the determination to turn to renewables or nuclear quickly. Figure 8 displays the standard picture of more economic output – more CO2:s.

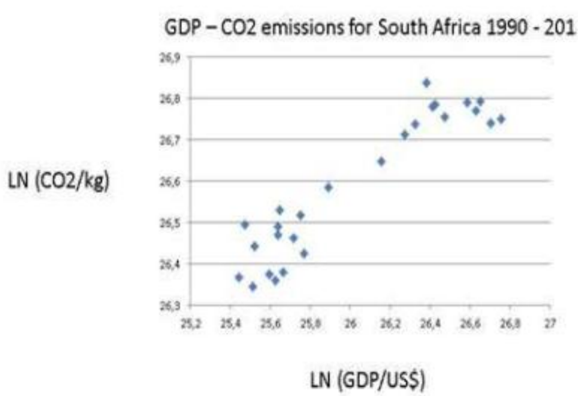

Figure 8. *GDP and emissions 1990-2015: y = 0,3492x; R^2 = 0,8729*

The RSA may not have the policy know how or preferences and motivation to cut the coal consumption fast as well as radically and move to solar energy, for instance? Or would the RSA renege on COP21 – the always available option in collective action endeavours?! South Africa needs the Super Fund and a major change in government policy priorities.

Oil dependency: Algeria

Some African countries produce lots of oil and consume some of it themselves. One country almost only relies upon oil and gas.

Algeria

Algeria is a major exporter of natural gas and oil, Thus, we expect that it relies exclusively on fossil fuels, like Mexico, Iran and the Gulf States. Figure 9 verifies this expectation.

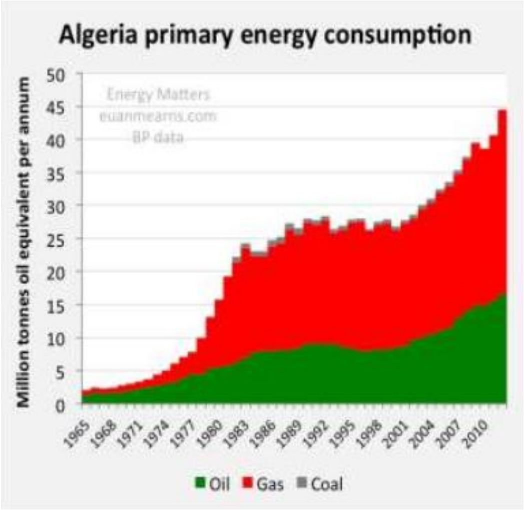

Figure 9. *Energy mix in Algeria*
Source: [Retrieved from].

Although Algeria may have great trust in the availability of future fossil fuels resources in the country, it still faces the demand for a 30-40% reduction of its CO2 emissions from the COP21. Emissions have thus far followed the economic progress very closely– see Figure 10.

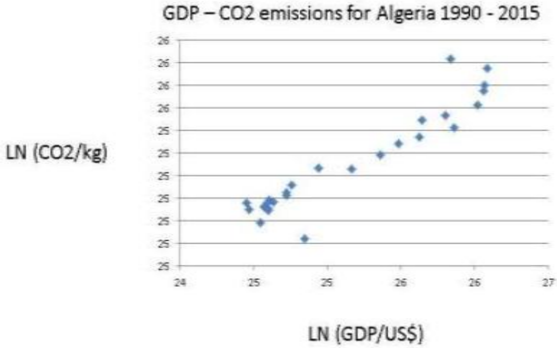

Figure 10. *GDP-CO2 in Algeria: y = 0,81x; R^2 = 0,93*

The truth is that Algeria pollutes heavily. It is of course the need for energy that drives the augmentation in CO2:s. Figure 11 documents the GDP-energy link

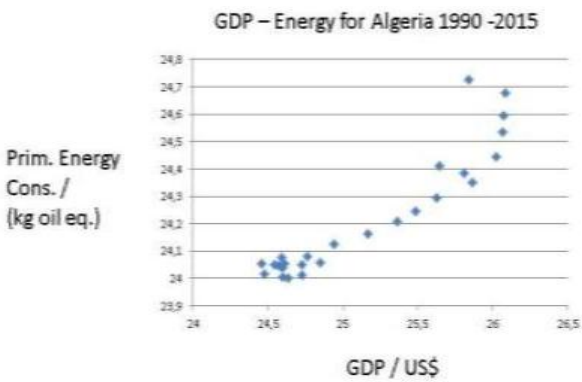

Figure 11. *GDP and energy: y = 0,3481x; R^2 = 0,8702*

One would naturally suggest solar energy as a viable alternative to the heavy dependence upon fossil fuels in Algeria, given its immense Saharan territory. Yet, Algeria has been plagued by the attacks of terrorists or looters. But solar energy from Sahara would be very interesting for the EU.

Gas dependency Egypt

Egypt has a huge population with high unemployment and mass poverty, besides a high level of political instability, resulting from religious conflicts. But surely it has electricity from its giant Assuam dam and the Nile? No, hydro does not count for much for Egypt, where most people live in the Nile delta. CO2:s are on a sharp upward trend for Egypt, because it relies mainly upon fossil fuels, like gas and petrol.

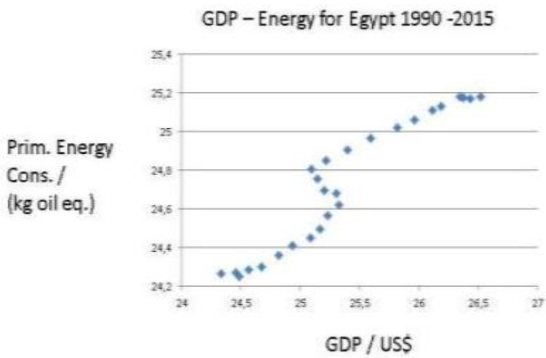

Figure 12. *Energy and GDP in Egypt: y = 0,4881x;* R^2 *= 0,9069*

Egypt relies upon huge gas assets in the south, exporting a lot. But its petroleum resources are dwindling. Egypt will have 100 million people, crammed in the Nile delta. It needs much more energy to uplift its population. CO2:s follow economic develoment in Egypt, as elsewhere – see Figure 13.

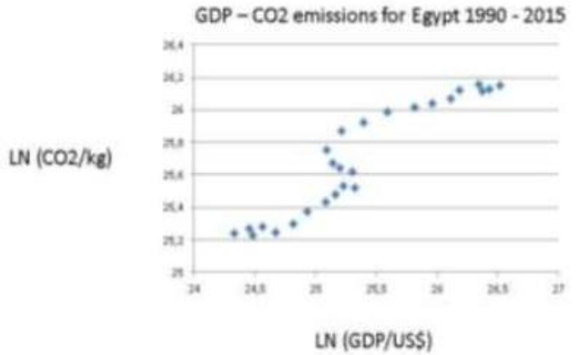

Figure 13. GDP-CO2 for Egypt: y = 1,02x; R^2 = 0,99

It will be very difficult for Egypt to make the COP21 transformation, at least without massive external support. But where to build huge solar power plants in a country with terrorism, threat or actual? The share of hydro power is stunning low for a country with one of the largest rivers in the world. Actually, the water of the Nile is the source of interstate confrontation between Egypt, Sudan and Ethiopia, because the latter two have started to exploit it recently on a large scale.

As Egypt relies almost completely upon fossil fuels, it has massive CO2 emissions (Figure 14).

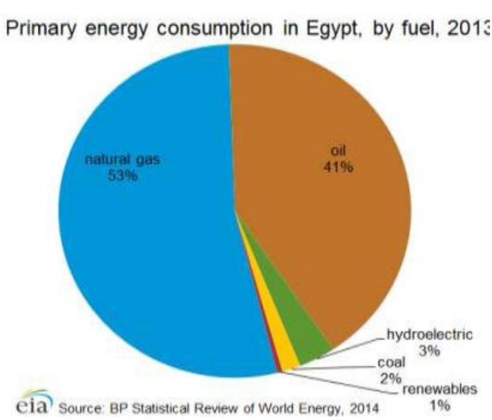

Figure 14. *Egypt's energy mix*

Egypt has made progress with wind energy, but its economy is too weak for the COP21 transformation, as the country is dependent upon US support yearly.

Dependency on Oil and Biomass

An enormous reliance upon traditional renewables is to be found also in Africa, like in e.g. Angola and Nigeria, although both have access to massive fossil fuels: oil and gas. Figure 15 describes the energy mix for Angola.

Angola

This country has quite substantial CO2 emissions that follow economic development, as usual – see Figure 15.

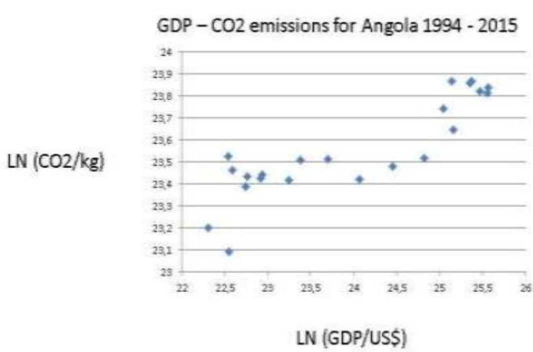

Figure 15. *GDP and CO2:s for Angola: y = 0,1576x; R^2 = 0,7532*

One would be inclined to surmise that the explanation of the upward curve in Figure 15 is the consumption of oil. Angola has become a major petrol exporter, to the benefit of the ruling family. However, the country also employs wood coal in large quantities that are very polluting (Figure 16).

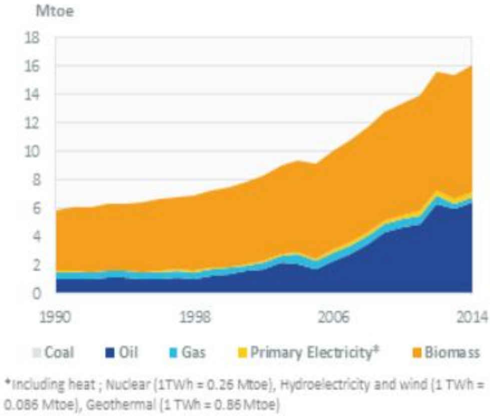

Figure 16. *Angola's energy mix*

Angola has suffered from long and terrible civil war. In the many poor villages, energy comes from wood, charcoal and dung – all with negative environmental consequences. Angola has immense fossil fuels – oil and gas, but the political elite family with a Marxist background prefers to export much of these resources instead of using them for internal electricity generation.

Nigeria

Surprisingly, Nigeria relies much upon traditional renewables, reflecting the poverty of the country. Yet, also wood coal emits CO2:s. This, Nigeria pollutes much totally, although not per capita. Figure 17 shows a somewhat erratic trend that is upward

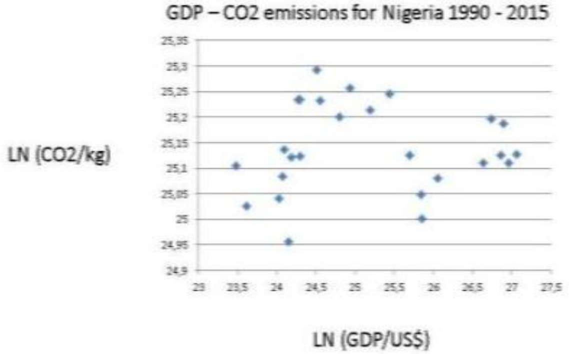

Figure 17. *Nigeria: GDP-CO2 link: y = 0,0032x; R^2 = 0,0018*

Giant Nigeria has a resembling energy mix as Angola, with lots of biomass – see Figure 18.

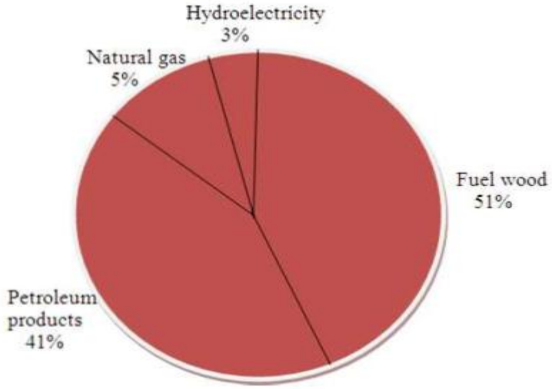

Figure 18. *Nigeria's energy consumption*
Source: Sustainable Energy, 2013 1 (2), pp.14-25.

As a matter of fact, wood coal is as polluting as stone coal, and worse than oil and gas. Nigeria is a country with deep environmental problems and definitely in need of foreign assistance. Besides the oil spills, the risks of global warming are tremendous, with droughts, etc.

Gabon

Another very telling example is Gabon, where Chinese exploitation cuts down the precious forest, funding the buying streak of the ruling clan, including property in France (Figure 19).

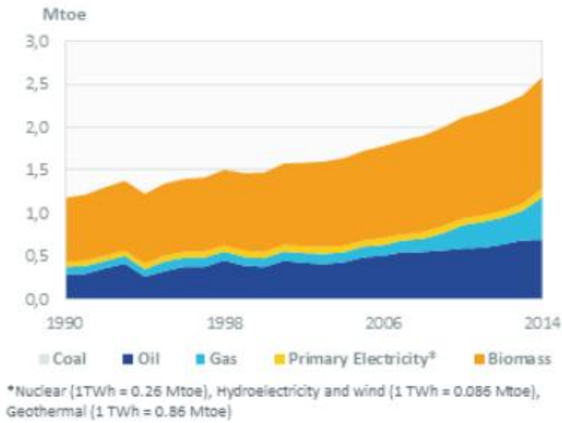

Figure 19. *Energy consumption in Gabon*
Source: [Retrieved from]. update 2015.

Despite its big oil and gas resources, much of the poor population relies upon biomass, i.e. wood coal with its consequences for deforestation and desertification.

Oil and coal dependency Morocco

Despite the enormous success of its huge solar panel plant at *Quarzazate* Morocco remains much dependent upon imports of fossil fuels - see Figure 20.

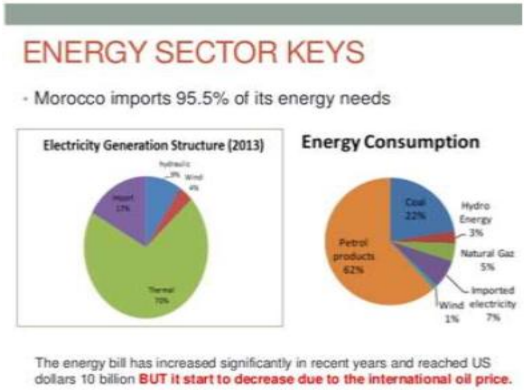

Figure 20. *Energy mix in Morocco*
Source: [Retrieved from].

In order to reduce fossil fuel dependency in the century, Morocco with a rapidly growing population will need more similar plants, which presupposes that assistance will be forthcoming from the COP21 project. Actually, the CO2:s are substantial in this nation. Its solar plant is a model for the entire Sahara, but this huge desert area needs political stability, lacking in several Saharan countries.

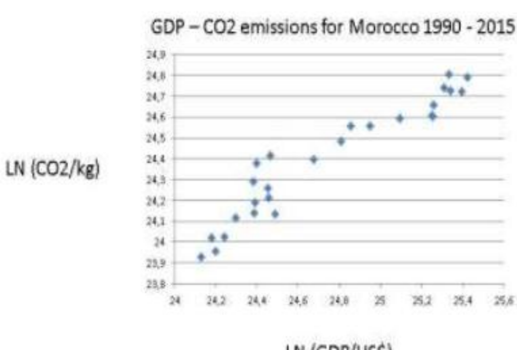

Figure 21. *GDP and emissions in Morocco: $y = 0{,}5846x$; $R^2 = 0{,}9124$*

Botswana

African countries have sometimes both a traditional and a modern economy. Take the case of Botswana, a democracy with a market economy and traditional chiefs! It has considerable CO2:s despite a rather small population – see Figure 22.

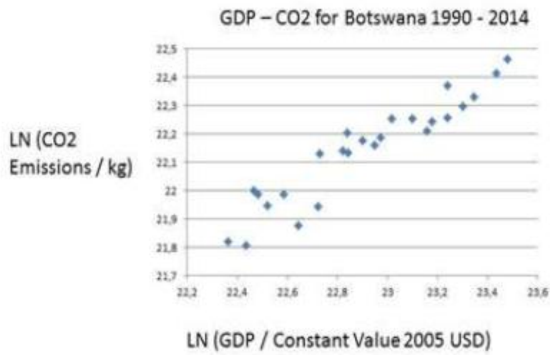

Figure 22. *Botswana: GDP-CO2: $y = 0,51x$; $R^2 = 0,89$*

Yet, Botswana relies mainly upon fossil fuels, oil and coal, to deliver its economic output from mining and minerals (Figure 23).

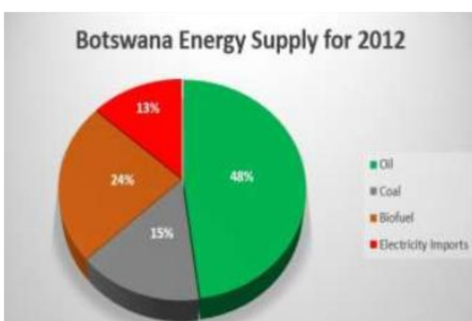

Figure 23. *Energy consumption in Botswana*

Complying with the CO2 objectives, Botswana can use solar power to diminish the scope of fossil fuels or that of traditional renewables. Botswana has peace, which is extremely important for energy policy-making.

Wood coal and hydro

In the climate change discussions and policy-making, it is often stated that renewables should be preferred over non renewables. Yet, this statement must be strictly modified, as there are two fundamentally different renewables:

- Traditional renewables: wood, charcoal and dung. They are not carbon neutral. On the contrary, employing these renewables results in severe pollution, not only outside but also inside household;

- New renewables: solar, wind, geo-thermal and wave energy that are indeed carbon neutral, at least at the stage of functioning.

In the poor African countries with about half the population in agriculture and small villages, traditional renewables constitute the major source of energy.

Kongo Kinshasa

One understands the hefty use of wood coal in this giant country, so plagued by political instability, anarchy, anomie and civil wars with foreign involvement (Figure 24).

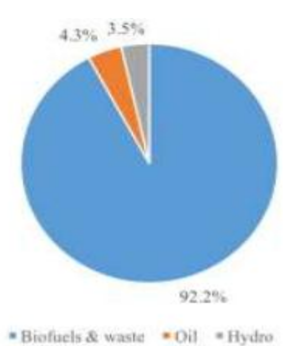

Figure 24. Dr Kongo's energy mix
Source: Democratic Republic of Congo - Energy Outlook.

Kungliga Tekniska Hoegskolan One notes how little of hydro power has been turned into electricity in Kongo, but economic development and political instability, civil war and anarchy do not go together normally. At the same, one may argue that an extensive build-up of hydro power stations would pose a severe challenge to the fragile environment in the centre of Africa. Kongo can now move directly to modern renewables like solar power.

Sudan

The energy consumption of Sudan reflects this situation – Figure 15. The countries relying upon traditional renewables to an extent up to 50 per cent or higher will have to reflect upon how to bring these figures down sharply with modern renewables. It is an entirely different task than that of countries with too much fossil fuel dependency. Hydro power has increased in Sudan, which is a positive. But the water of the Nile can last only so long for three energy power hungry nations.

Sudan is dismally poor with deep-seated internal conflicts ethnically. How to move to large solar panel plats in a country with so much political instability resulting huge numbers of death from domestic violence? Figure 25 shows the energy mix before the split up of this huge country.

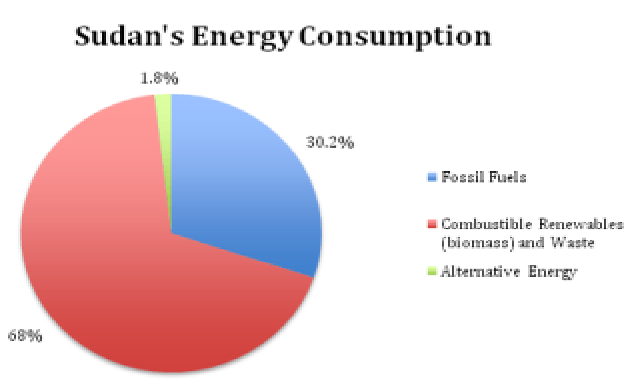

Figure 25. *Sudan's energy mix*
Source: [Retrieved from].

Ethiopia

The reliance upon traditional renewables is so high in neighbouring Ethiopia that electrification must be very difficult to accomplish over the large land area. Figure 26 displays a unique predicament, although a few hydro power stations have increased hydro power substantially since 2008.

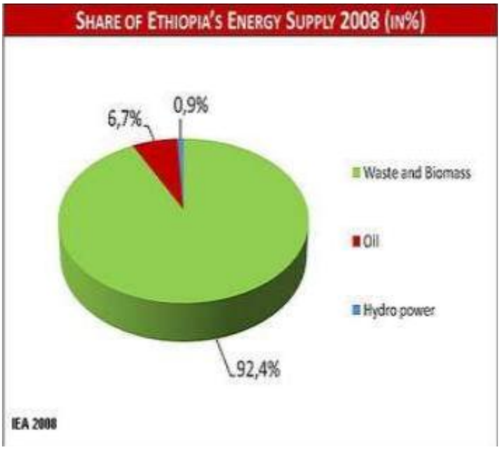

Figure 26. *Ethiopia's energy mix*

Are there any advantages with such a skewed energy mix? No, because even mainly rural Ethiopia delivers with lots of CO_2: - see Figure 27

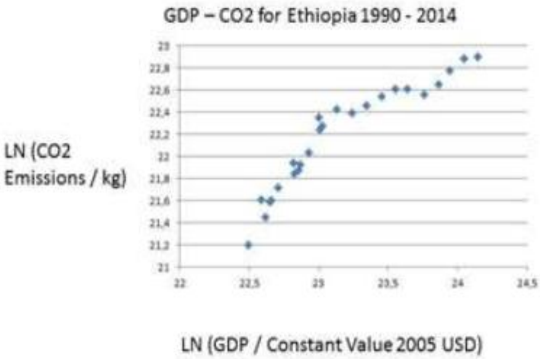

Figure. *Ethiopia: GDP and CO2: y = 0,90x; R^2 = 0,88*

The zest with which Ethiopia is pursuing its control over water resources becomes fully understandable, when Figure 26 is consulted. What we see is the same smooth linear function plotting CO2:s upon GDP, as is obvious in countries based upon fossil fuels – see below. For Ethiopia, to comply with COP21 goals is going to pose major challenges, especially if economic development is not going to be reduced. The country needs massive help, both financially and technologically.

The Grand Ethiopian Renaissance Dam in Ethiopia and the Merowe Dam in Sudan bring electricity to Africa. Hydro power could be much more exploited in several African countries, but time is running out. Global warming reduces rivers and enhances draughts. Solar power is the future for all nations, whatever pattern of energy consumption they now have.

Ghana

One of the promising nations in Africa is Ghana, housing both democracy and positive economic development. Figure 28 shows its GDP-CO2 picture for the last two decades, when things have gone well and peacefully.

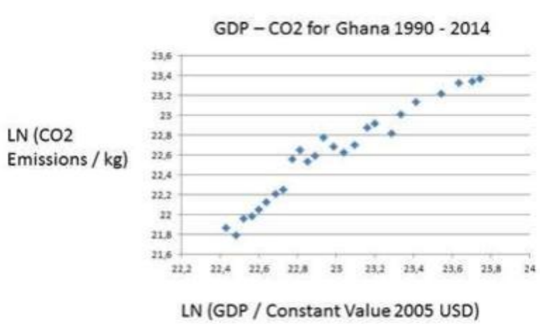

Figure 28. *Ghana: GDP-CO2: $y = 1{,}17x$; $R^2 = 0{,}94$*

There is a very strong connection between GDP and CO2 emissions in Ghana. One would like to examine its energy mix in order to understand this. Figure 29 presents the energy consumption pattern in Ghana.

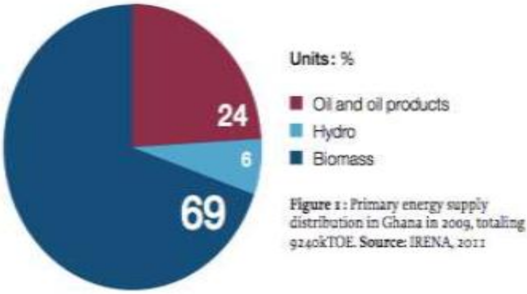

Figure 29. Ghana's energy mix
Source: [Retrieved from].

The dominance for fossil fuels and wood coal is enormous in Ghana, but they have hydro energy, which is very positive. Many African could have done much more with hydro power, if they had had access to capital. Now they must turn to new renewables: solar, wind and geo-thermal power. The same observation applies to East Africa.

East Africa

The East African region of African continent has become more economically dynamic recently with successful regional integration. Yet, the reliance upon biomass is as Figure 30 shows typical of rural East African countries. As some 50 per cent of the inhabitants live in rural villages, this use of wood coal puts an enormous pressure on the forests.

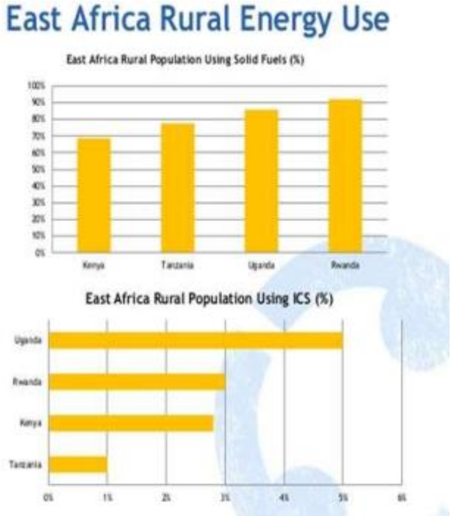

Figure 30. *Energy mix in rural East Africa*

People in the urban areas have an entirely different energy consumption pattern. Positively, hydro power is important in these countries – see Figure 31. Here we are talking about electricity consumption and not overall energy mix.

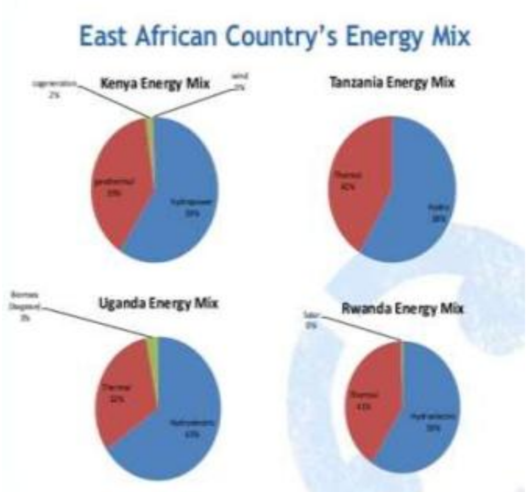

Figure 31. *Hydro power in East Africa*

What these countries need to is to replace the wood coal with electricity from hydro and geo-thermal resources. The status of biomass or wood coal from the point of view of GHG:s is contested. On the one hand, it is clear that wood coal in its various forms is not carbon neutral when consumed, but on the other hand it is claimed that wood products have already consumed lots of carbon when growing. Whatever, the balance may be, the forests are being cut down, contributing to deforestations and desertification.

In Figure 32, we see that CO2:s follow GDP in Kenya, a strongly developing country in East Africa, relying upon the market (Hayek, 1991). Thus, also Kenya will face difficulties complying with the COP21 goals: Goal I, Goal II and Goal III – see above

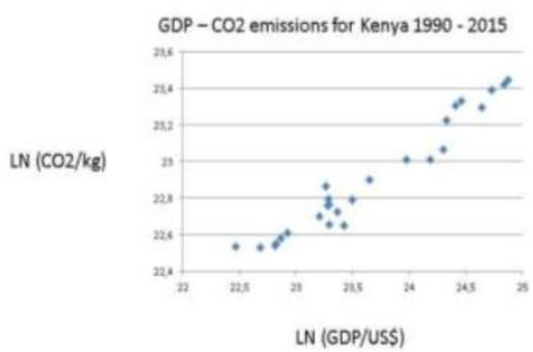

Figure 32. *GDP - emissions for Kenya: y = 0,4154x; R^2 = 0,9501*

The GDP-CO2 curve for Kenya is the sme as for most African countries, meaning upward sloping. Africa needs energy as well as basic energy transformation – an enormous challenge.

Zambia, Mozambique and Senegal, Cameroon

The same picture of an energy mix dominated by wood cool is to be found for several other African nations. Biomass counts for 50 per cent of more of total energy consumption, complemented by not more than 10 per cent hydro power while the remaining comes from fossil fuels. This puts too much pressure on African forests. And there will be massive CO2 emissions, because these wood resources are never replaced.

The road ahead is not more fossil fuels, but modern renewables like solar, wind and geo-thermal power replacing wood coal and its derivatives. We quote from the U*N*.

Convention to Combat Desertification

Two-thirds of the African continent is desert or dry lands. This land is vital for agriculture and food production, however nearly three-fourths of it is estimated to be degraded to varying degrees. The region is affected by frequent and severe droughts, which have been particularly severe in recent years in the Horn of Africa and the Sahel. Poverty and difficult socio-economic conditions are widespread, and as a result many people are dependent on natural resources for their livelihoods. For many African countries, fighting land degradation and desertification and mitigating the effects of drought are prerequisites for economic growth and social progress. Increasing sustainable land management and building resilience to drought in Africa can have profound positive impacts that reach from the local to the global level [Retrieved from].

Before desertification often comes deforestation. It is often stated that land hunger drives deforestation. But equally relevant is the search for energy. We quote from a study: Forests in Zambia are important in supporting life especially in low-income communities both in urban and rural areas. A variety of wood and non-wood forest products are utilised by industries, rural households and urban households in various parts of the country. However, today the forests in the country have been made vulnerable to both man and natural induced disasters. The rate at which forest cover is being lost has increasingly become high such that if this trend is left unchecked time may trigger the complete loss of biodiversity embodied in the Zambian forests. Perhaps the highest loss of forest cover was from 1990 to 2000 with a significant decline of 851,000 ha forest loss per year (FAO 2001).

Deforestation as a result of land use change towards agriculture, illegal settlements and Current unsustainable levels of utilisation to mention but a few have contributed to the loss of forest cover in Zambia and the Southern Africa as a whole. The critical question seeking urgent redress is why forests in Zambia are being destroyed more and more [Retrieved from].

Conclusion

African nations may rightfully claim a fair share of the energy consumption in the word, meaning in proportion to its share of global people. The catch-22 problematic is that African governments have signed the decarbonisation Treaty of the UN and must now proceed to implement it, but how to increase energy while decreasing CO2 emissions? Answer: Use renewables like solar, wind and geo-thermal power!

Nuclear power is probably too expensive and difficult to master. Morocco has set up the largest solar power plant in the world, serving some 2 million inhabitants with electricity.

Several hundred millions of Africans are without safe and secure electricity, holding back socio-economic development. But such gigantic investments are only feasible with massive support from the promised Super Fund in the COP21 project.

In my view, the COP21 may be at risk due to a likely American defection. Thus, the only practical solution to the dire global warming is that G20 takes on the problem and cuts down their emissions without all the philosophical debates about elimination of poverty, promoting green sustainability and the other SDGs (*sustainable development goals*). As the G20 is responsible for much of CO2s, they can fix the problem in a transaction cost efficient manner, asking all other counties to cut at least somewhat now and more later.

Poverty on the African continent reflects the energy situation.As African nations increase energy, they must at the same time reduce CO2:s. The COP project is a great opportunity for African peoples, but the promise of support must be forthcoming. If the US reneges, then Africa will suffer. Defection is not the solution to the threats of global warming.

Appendix

An effort to model the greenhouse gases, especially CO2:s, in terms of a so-called identity is the deterministic Kaya equation. The Kaya identity 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). *Kaya's identity* links carbon emissions on changes in population, economic activity as GDP per, energy intensity and carbon intensity of energy. I make an empirical estimation of this probabilistic Kaya model - a cross-sectional test for 2014:

(E2) k1= 0,68, k2=0,85, k3=0,95, k4=0,25; R2 = 0.885. 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) 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 above that GDP increase with the augmentation of energy per capita. Decarbonisation is the instrument believed to undo these dismal links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy.

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12 Can the COP21 stop the rise of CO2s

Introduction

In the great debate between *climate change deniers* and *climate change asserters* the question is the preponderance of evidence, and not beyond reasonable doubt. The global warming hypothesis is falsifiable in Popper' philosophy of science. Thus various doubts may be put forward. But the evidence collection so far supports the climate change hypothesis. Even worse, there is reason to fear irreversibility

The Social Sciences have discussed for a long time whether rational comprehensive decision making is possible in public institutions like government. In classic economic theory market actors were assumed capable of rational decisions explaining the law of demand and supply. However, management theory of the firm denied this, launching instead the Herbert Simon incrementalism.

So successful were the teachings of the so-called Carnegie School of organization theory that all large organizations, private or public, were modeled as making decisions or policy incrementally, i.e. focusing only upon marginal changes.

Two American political scientists, Charles Lindblom and Aaron Wildavsky, took the teachings of James March very literally, modeling government and public administration as piecemeal disjointed marginalism. Certainly. International public organization was no exception, although matters could be even worse: irrational decision making or the garbage can in Joined Johan Olsen's words. How, then, could mankind counteract climate change by rations policy making?

Hawking's irreversibility

Global astro physicist Stephen Hawking stated in an interview some time before his death in 2017 that planet Earth had entered unstoppable climate change. Refuting comments were made by for instance Dane Bjorn Lomborg. We know that Hawking might have exaggerated, but today we ask ourselves if we are beyond the point of no return with slowly but steadily worsening environmental degradation.

Global climate policymaking is far away as few countries take the Paris Agreement seriously. Examining the energy plans of the largest and most polluting nations, one discovers no impact of Paris promises.

It is well-known that international decision-making is slow with high transaction costs.

The UN bodies have met for many a year and large enquiries have been published. Yet, little policymaking towards the chief problem, coal, has been achieved.

Lomborg and the cornucopians

It should be mentioned that there are a few famous scholars claiming that climate change is either not taking place at all or that it has been exaggerated. The criticism of environmentalism might have contributed to the slower development of an anti-global warming policy by the UN. The shift to electric engines in new automobiles is extremely positive but will not be sufficient. One should attack the core of the problem, namely the demand of supply of coal fired energy.

The Cornucopians challenge environmentalism by rejecting not only global warming but also general environmental degradation. Their theory is today expanded by Bjorn Lomborg in several publications, but it was formulated by economist Julian Simon and political scientist Aaron Wildavsky. The Earth is plentiful, they stated, and highly resilient to various kinds of usages. Environmentalism is merely a myth constructed in order to frighten the public, as well as to criticize the prevailing economic system, i.e. capitalism.

Lomborg suggests that one should not concentrate on reducing CO2s and rather keep using fossil fuels. He maintains that planet Earth has other more urgent priorities: reducing starvation, clean water and halting the spread of HIV. These are completely arbitrary, because the world can do all of this and simultaneously reducing carbon pollution in major world metropolitan areas, e.g. New Delhi, Beijing and Paris.

Notion of irreversibility

In the context of environmental change irreversibility is a most dire concept. It entails that there is no restoration of an earlier equilibrium possible whatever the size of change involved. There is a real risk that planet Earth is on a slow evolution towards ever hotter predicaments, eliminating numerous species. All known feedback loops are positively reinforcing climate change

It is not known what the time process looks for global warming: how much and when and how if any negative feedback loops could be released, then a new stationary would be possible.

Human interaction or climate policymaking: The development of events could be changed by a large scale policy against the most polluting of the fossil fuels, namely coal. But it requires non-incremental decision-making - can this be done by an international body?

The attempts at implementing climate policy are thus far only successful at the national level. Tabtemperature rise to plus 2 degrees up to 2050. At the time markets adapt to.the new situation or expectations thereof. The arrival of electronic cars is a great innovation for the halt to Co2 rise. In the energy supply there are several changes or plans for innovation in order to rely more upon renewable sources of power.

Yet, despite all the announced changes people feel that things are not moving quickly enough. Thus, we witness growing citizen concern in global mass protests. The US government still shirks despite the many signs that young people believe their futures are being compromised.

Earth CO2 thermometer

Is the planet already at its Hawking's point in time? The notion of irreversible transformation is very menacing, as policy could only slow down the arrival of a global disaster

There is a way to find out about irreversibility, namely to consult the global thermometer CO2 daily: 10 November at 410 ppm and 408 one year ago (CO2).

As long as the "fever" goes up, hope diminishes. Why, then, cannot irreversibility be excluded? Because demand and supply of fossil fuels and energy is all but static.

Sanguineness

Well-known commentator on climate change, Professor Johan Rockström at Stockholm University now suggests that Environmental Science and Earth Sciences have reached an understanding of safe global limits for the survival of mankind in its present biological and chemical form. Thus, the question is merely to derive policies that enforce these limits, one of which is the amount of carbon dioxide in the atmosphere. No doubt the Earth Sciences have made great progress since the initial warnings of global warming. However, we still need much more information. First, the *exact* relationship between atmospheric concentration of CO2 and global temperature is not fully understood. Second, we don't know *when* the impact of climate change could be unsupportable for various species as well as man. Third, we are ignorant about the possibilities and costs of wide-scale carbon capture / elimination as well as storage.

Professor Rockström appears to state that since we can estimate the limits of bearable environmental damage, we will automatically take action to enact them. Why? Knowledge does not always translate into action. The United Nations and its intergovernmental conferences have no sound policy making procedure for combatting global warming.

Energy today and tomorrow

The demand for energy is rising rapidly meaning fossil fuels may only diminish relatively. Look at the BP global images in Figure 3 in the conclusion. In this projection energy demand grows sharply as economic growth and development keep rolling on in both rich and poor countries - unstoppably it seems at least. Renewables are poised to replace coal, but it is merely a chimera. Coal will be reduced relatively speaking but not.much absolutely. As oil and natural gas will predictably increase, the necessary decrease in fossil fuels is illusory.

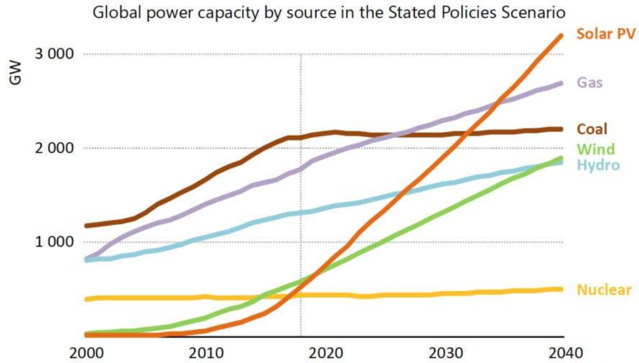

Figure 1. *Global power capacity projection (Source: IEA).*

Here we have ILLUSION ONE that makes Hawking's irreversible thesis relevant for climate policymaking nationally or internationally:

Illusion 1: Coal or fossil fuels will decrease very much absolutely up to 2035.

Coal – Will it disappear?

The culprit in the global climate crisis is first and foremost coal. Coal is the dirtiest of all energy kinds, but it is also used on huge quantity in several countries. It is not difficult to reduce the burning of stone coal but what about wood coal or charcoal?

Charcoal is the conundrum of the energy of poor people - how much is burned every year? Charcoal is wood with many use, in poor countries it is a most vital source of heat and energy. Charcoal is derived from the trees in forests, resulting in an enormous pressure upon the forests around the world.

Charcoal is produced from wood and is easily traded. As wood in the forests is an open access resource it is bound to be depleted. Charcoal is the poor man's free riding, to be exported to fellow poor families. The whole process of producing and contamining charcoal releases of Co2.

Here we have some quotes about charcoal in Latin America:

> "According to a new FAO report, Latin America and the Caribbean at the global level is only surpassed by Africa in terms of per capita production and use of charcoal.
> The FAO report, The Charcoal Transition, points out that Latin America and the Caribbean produced about 8.9 million tons of coal in 2015, surpassed only by Africa, which produced 62 percent, 32 million tons.
> Brazil is not only the largest producer in the region, but the country that produces the most charcoal in the world: it generated 6.2 million tons in 2015, 12% of global production.
> More than 90 percent of wood-derived coal in Brazil is used by the industrial sector, with the metallurgical industry using 80 percent of the total.
> In other countries of the region, however, coal is mainly used in the food industry and in households."
> (FAO)

Illusion 2: Coal may be much reduced although charcoal will keep diminishing world forests.

Povery and energy: A strong link

The charcoal story implies that poverty enters the global environment conundrum. The coordination bodies of the UN and WB, IMF and WTO work for two chief objectives:

A) Reducing poverty

B) Reduce CO2s.

This is not the place to analyse at length the various policies for alleviating poverty around the globe. What is to be.emphasized is that poverty reduction necessarily involves country economic growth or development. Thus, the enormous economic advances in East Asia have lifted millions out of poverty. But the price is heavy air pollution. India is faced with the very same problematic - rapid economic growth versus environmental degradation.

Figure 3 shows the overall picture for a selection of 173 countries (data from World Bank)

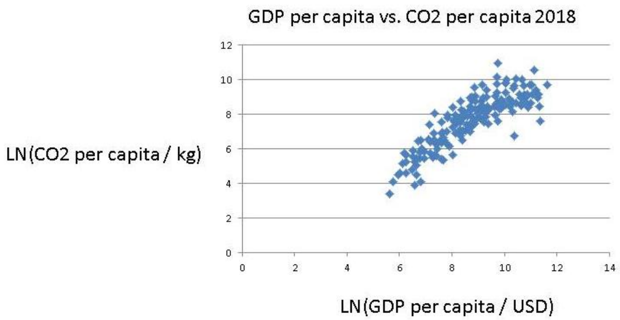

Figure 3. *GDP per capita – CO2 per capita 2018, log-log scale.*

Poor countries can NOT bypass the general relationship between socio-economc development on the one hand and increasing CO2 demand on the.other hand. The two horns of this global dilemma are poverty reduction and CO2 increased where both outcomes are driven by economic growth. It is urgent to invent how development can be promoted by carbon neutral economic growth.
Illusion 3: Development can be carbon neutral.

Nuclear power: Not an option?

Several countries have decided to abandon their nuclear plants for renewables. To shut down and dismantle an atomic station is extremely costly, especially if done prematurely. The Fukushima catastrophe became a starting signal for atomic power close down in Germany and France. However, Sweden began already around 2000 to prematurely abandon nuclear power. One can mention that Sweden is about to replace atomic power with a large expansion of biomass. However, burning biomass also results in CO2 emissions and other forms of pollution. The thesis that biomass is carbon neutral is flawed, because it requires that forests are cleared, and they may not be replaced. Sweden has much lower CO2s than capita than Denmark and Norway, but it may simply be an accounting trick.

Illusion 4: Nuclear Power is more damaging for the environment than biomass.

Solar power

Below we make an attempt to calculate how much solar energy would be required to replace coal power. As benchmark the Bhadla Solar Park in India is used, projected to deliver 2255 MW once construction is ready from December 2019. In all, 900 such plants would be necessary to completely eliminate all coal power generated in 2018. Table I illustrates how many solar plants of this size each of the ten biggest coal producing nations would need to install to replace their entire coal power production.

Table 1. *Number of Bhadla Solar Park plants required to replace coal power by country (Global Energy Monitor).*

Country	Number of plants
Asia:	
China	475
India	100
Japan	28
South Korea	18
Thailand	2
North Korea	2
Americas	

United States	106
Colombia	1
Europe	
Germany	32
Russia	30
Africa	
South Africa	14

Illusion 5: One can phase out coal power slowly, with replacements of biomass.

The global close down of coal fired power and heat would signal the environmentalism is top priority. It can be combined with activities against plastification of ocean and sea, the turn to electric cars, etc.

Conclusion

It remains to be seen if the UN coordination efforts result in any concrete policy. The revolution in the car industry helps of course, but the Co2 thermometer keeps ascending.

The risk for global environmentalism is that it becomes a movement of despair and protests only. One may say that we know much more now than a mere 10 years ago about the natural limits of our civilisations. However, how are the necessary restraints to be introduced and enforce?

Environmentalism must now attack the sources of the problematic: fossil fuels. By closing down coal fired power plants and build a stream of solar power plants, a major step in the right direction would be taken. This is non-incremental policy making on a global scale, which is the only chance mankind has to avoid Hawking's irreversibility. Otherwise, we end up in the scenario in Figure 3, where fossil fuels and in particular coal dominate the energy sector in spite of a surge for renewables. Countries must use solar power as *substitute* for coal power, and not as *supplement*.

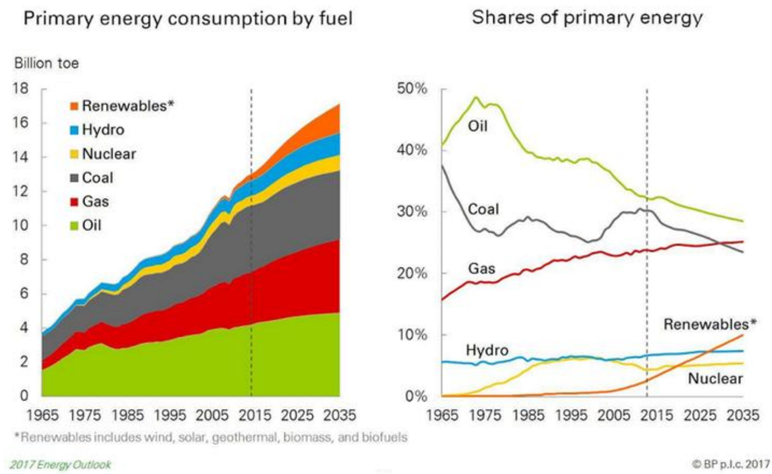

Figure 3. *Primary Energy projections (BP).*

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13 The great drama, global warming and its mechanism

Introduction

The process of climate change is to be regarded as a phase in planet Earth's evolution. It has the Hawking's irreversible property meaning it will get warmer - how fast depends on human activity. There are four functions involved in global warming equations, namely.

1). Energy = Power
2). CO2 concentration = Energy
3). CO2 concentration = Temperature
4). Temperature = Global warming outcomes

Demand for and supply of energy

Here we concentrate upon the second and the third equations. The major energy consuming countries in total are the giant with large populations. The major energy consumption per capita countries are the affluent ones.

Whatever one produces energy is demanded. However and wherever one lives energy must be supplied.

Governments know that energy is vital whether facing or poor countries. All of them plan for considerable increases in energy consumption. Of course, military might depends upon easy access to oil, gas or uranium. In the Eastern front e.g.t he Wehrmacht often lacked petrol for some of the tanks. Hitler took the fatal decision to divide the OSTHEER into 3 armies sending one of them to chase oil in the Baku area. where Nobel's brother had started oil fields. Japanese aggression in East Asia was driven partly by hunt for energy. Today Japan faces a severe stable energy shortage. When the USSR couldn't supply cheap energy to its empire it was a sign of coming collapse.The connection between energy and economic development or growth is similar.

International governance and coordination failure

The UN has attempted international governance of climate change by means of its COP program and other efforts as well. Max Weber stated that we must analyse action as oriented in terms of ends and means. But the many COP meetings with massive participation has thus far only delivered goals - lower CO3 emissions - no means.

Climate change AFFIRMERS warn of the dire effects of global warming. Climate change

DENIERS ridicule this. Global opinion seems to swing in favour of the former now but most

Government dirty support the latter. One would like to know when the outcomes of global warming become truly horrific. If it is the case that climate change is unstoppable (Hawking irreversibility), then when will this be undeniably visible? Several ecological disasters occur new weekly around the globe. Are they due to rising temperatures? Ecologists speak of a gigantic crisis for Planet Earth with the extinction of many species, True ? Gould global warming be indirectly the cause of many disasters?

A tentative model

The yearly rises in average global temperature are well documented. Diagram 1 has the overall picture for more than one hundred Years, starting from 1880, set as 0. What could account for these ups and downs? Following the discovery or scientific revolution by S. Schneider, we try the amount of CO2 emissions yearly. Thus, we have:

x=atmosphere concentration CO2 in ppm
y= change in global surface temperature relative to 1951-1980 average temperatures

Regression line: $y = -3{,}4277 + 0{,}0106x$ (1)

Increase by 1 ppm CO2 leads to increase in global temperature 0,01 degrees CO2 concentration has grown from 315 to 410 so temperature has risen with c:a 1 degree as figure shows.

R-squared = 0.913. A spurious correlation ? Self-evident? No. Probably not, as it reflects the rising dependence on energy from fossil fuels. The fossil fuels are in much demand, because they offer cheap energy which is vital for affluence.

Is the planet already at its Hawking irreversibility? The notion of irreversible transformation is very menacing, as policy could only slow down the arrival of a global disaster There is a way to find out about irreversibility, namely to consult the global thermometer CO2 daily: 28/12 at 412 ppm and 408 one year ago (CO2).

Energy today and tomorrow

The demand for energy is rising rapidly meaning fossil fuels may only diminish relatively. Look at the BP global images in Figure 1 in the conclusion. In this projection energy demand grows sharply as economic growth and development keep rolling on in both rich and poor Countries – unstoppable it seems at least. Renewable are poised to replace coal, but it is Merely a chimera. Coal will be reduced relatively speaking but not much absolute.

This is not the place to analyses at length the various policies for alleviating poverty around the globe. What is to be emphasized is that poverty reduction necessarily involves country Economic growth or development. Thus, the enormous economic advances in East Asia have Lifted millions out of poverty. But the price is heavy air pollution. India is faced with the very Same problematic - rapid economic growth versus environmental degradation.

Poor countries can NOT bypass the general relationship between sociology-economic development on the one hand and increasing CO2 demand on the other hand. The two horns of this global dilemma are poverty reduction and CO2 increased where both outcomes are driven by economic growth. It is urgent to invent how development can be promoted by carbon neutral economic growth. Development can be carbon neutral.

Several countries have decided to abandon their nuclear plants for renewables. To shut down and dismantle an atomic station is extremely costly, especially if done prematurely. The Fukushima catastrophe became a starting signal for atomic power close down in Germany and France. However, Sweden began already around 2000 to prematurely abandon nuclear power. One can mention that Sweden is about to replace atomic power with a large expansion of biomass. However, burning biomass also results in CO2 emissions and other forms of pollution. The thesis that biomass is carbon neutral is flawed, because it requires that forests are cleared, and they may not be replaced. Sweden has much lower CO2s than capital than Denmark and Norway, but it may simply be an accounting trick.

Below we make an attempt to calculate how much solar energy would be required to replace coal power. As benchmark the Bhadla Solar Park in India is used, projected to deliver 2255 MW once construction is ready from December 2019. In all, 900 such plants would be necessary to completely eliminate all coal power generated in 2018. Table I illustrates how many solar plants of this size each of the ten biggest coal producing nations would need to install to replace their entire coal power production.

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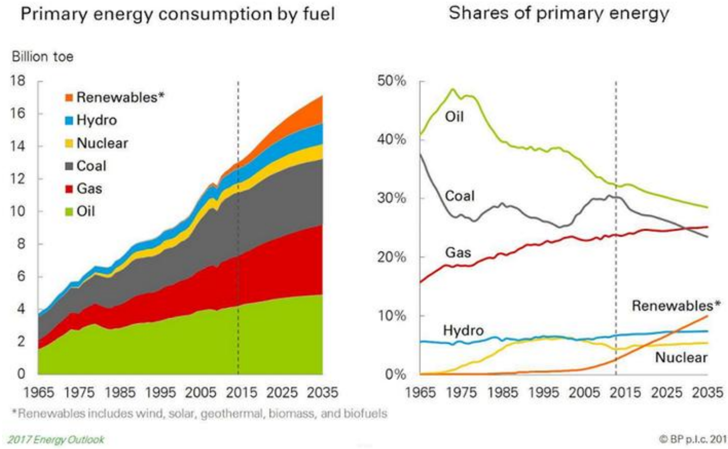
Russia	30
Africa	
South Africa	14

Sustainability

Following the logic of the model on (1), one cannot but arrive at a sinister future for mankind. At levels of CO2 over 450 ppm the negative outcomes of global warming will be much stronger. The best way to counteract is simply to close all coal plants right now. The global close down of coal fired power and heat would signal the environmentalism is top iority.

It remains to be seen if the UN coordination efforts result in any concrete policy. The revolution in the car industry helps of course, but the Co2 thermometer keeps ascending. One may say that we know much more now than a mere 10 years ago about the natural limits of our civilisations. However, how are the necessary restraints to be introduced and enforced?



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14 Global warming images

Introduction

Global warming - what are the facts? According to the philosophy of science this kind of question is irrelevant. What is the fact depends upon theory or set of models involved. Facts do not speak for themselves, but have to be interpreted in terms of some concept framework.

How significant is a temperature rise of around 1 degree Celsius? The history of global weather shows a number of swing. Perhaps this augmentation is just stochastic? One needS a model to tell whether the increase is accidentAl or not?

The climate change AFFIRMERS point at the CO2 concentration in the atmosphere of the Earth. Gobal temperature rise would reflect the greenhouse effect - here is a theory! A theory interlinkS diverse facts through a system of hypotheses, thus reducing contingency. When a theory creates a web of Interlinked modelS, then it may said tobe corroborated.

Value

The greenhouse theory is a realist set of models. But its main contender empathiseS bias As a subjectivist theory it sees climate change as a value ingrained set of models. It forms a part of general environmentalists blaming society and government not to respect and protect the environment enough.

Global warming is the Mother of environmental scares. Climate change AFFIRMERS use global warming themeto call for more regulation and state intervention, especially by means of gross exaggeration of ecological threats.

Climate change DENYERS come with two different approaches. Either one questionsingle the lack of systemic evidence for global warming or one rejects all forms of environmental beliefs as mere political propaganda.

Environmentalism - the thesis thar nature is being overexploited in a unsustainable way - was first rejected by economist Julian Simon with argument that low prices indicated plenty in nature. Aaron Wildavsky built a culture approach to explain why environmentalism and global warming received more and more support from citizens - environmentalism being left-wing egalitarianism. In culture theory the image of NATURE is what counts, individualS choosing their images or stories. The subjectivism of environmentalism proved attractive for political protest.

Many people hope that Dane Björn Lomborg is right when he downplays the relevance of global warming, but they fear it's consequences especially if irreversible.

It is impossible to bypass psychological aspects of global warming beliefs, but to assert that all is fabrication amounS to oversimplification. People who live in certain parts of a country may have perfect reasons to be afraid.

A corroboration of realistic climate change

The yearly rises in average global temperature are well documented. Diagram 1 has the overall picture for more than one hundred Years, starting from 1880, set as 0. What could account for these ups and downs? Following the discovery or scientific revolution by S. Schneider, we try the amount of CO2 emissions yearly. Thus, we have:

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Conclusion

While the postmodern theory implies no action, the realist theory targets C02s. It predicts the following consequences of CO2 emissions:

Global Energy / btoe	CO2 concentration / PPM	Temperaturerise / degrees C
16	430	1.1
18	450	1.3
20	470	1.5
22	490	1.7
24	510	2.0

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15 After Paris a new period mankind

Introduction

The Paris Agreement 2015 has a complex structure with several different mechanismstyles to reduce the pressures upon mankind from climate, change. Thus, it combines promise with market mechanism. Yet, the situation today is worse than 2015.

Interestingly, the inhabitants of the world may follow this unfolding drama day by day. The key is the so-called Keeling curve measuring the global CO2 concentration in the atmosphere. On the 4th of February it stood at 414.5, up.from 410,7 a year ago. It seems that global warming is accelerating. What can the next UN meeting do: COP 25 in Glasgow?

Resilience and adaptations

Since the Paris COP 20 general awareness of climate change has spread much among consumers and enterprises.

A new management theory is called for with private firms working for reducing their carbon footprint. Once started to find energy alternatives, both companies and individuals can do lots in favour of sustainability

The start of the transformation of the car industry is spectacular. Although, firMs are not fond of carbon charges they fear climate change. So far stock-markets neglect climate change. Perhaps economic life hopes for a successful adaptation from the large resilient countries?

Yet, some day later or rather sooner investors will take into account the risk of climate change, involving higher costs and lower demand. As hoarding money becomes attractive, the economy stops to grow. When? - a pertinent question. It all depends on the pace of global warming, which in turn deposits upon how much greenhous gases mankind puts out.

Non-excludability

Climate change is driven by the force of an externality: the external effect hits people who can not avoid it and benefits the people delivering it. Marfet failure occurs as the external effect can not be internalised as a cost or price. Negative externalities can be reduced only by government interventions like law or imposed charges.

The non-excludability of countries from greenhouse gases is at the core of the global warming problematical: it is advantageous for a country to burn fossil fuels without paying for the pollution damages, but all countries have to take the negative consequences of this pollution. This sets up the mutual interdependence between the countries of the world, to be handled by means of international governance.

For a long period of 30 years the United Nations have attempted a negotiated settlement about the necessary reductions of Co2s involving several steps towards the goal of zero emissions in this century. Thus far global governance has failed, as emissions keep increasing.an Agreement has been signed - Paris 2016, but it has no implement mechanism. The UN COP program has bought out a wealth of information supporting the greenhouse theory that argues that global average will rise with Co2 emissions; resulting in more negative outcomes. Why not cut back the source of the greenhouse gases: the fossil fuels?

Energy in global policy discussion

Global emissions cooperation has failed because what is at stake is energy and energy translating into economic and political power. Energy is needed all the time and for a huge variety of purposes. Changes in energy supply are accompanied by macro social transformation This holds true in agriculture; industry; services and military affairs Given the importance of energy in society and political matters, it is not astonishing that governments put a high priority onto having plenty of energy available somehow at a low cost. Our civilisations use energy to get to energy sources and the consumption of energy is a key element in providing for economic welfare in rich countries and economic development in poor countries.

In the industrial period of human existence energy from burning fossil fuels constitute the dominant sources, up 80% on average and more in a few countries. Besides there is atomic power; biomass and renewables as well as water power.

Thus; we arrive at the heart of the matter: Can greenhouse gases like Co2 be cut back without reducing energy consumption? Post Second World War developments have resulted in a dramatic increase in greenhouse gases - see Figure 1 - accompanying the equally conspicuous rise in energy consumption.

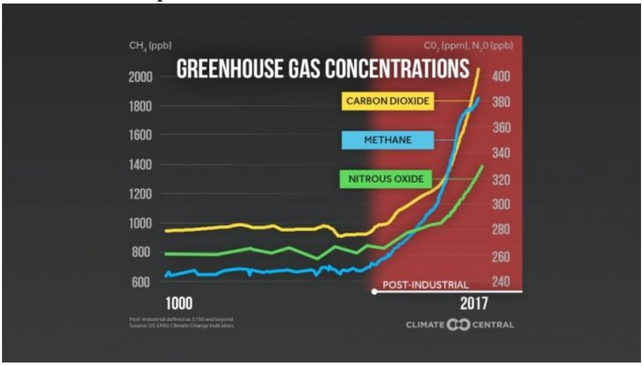

Figure 1. *Greenhouse Gas Concentrations from pre-industrial times to 2017 (Climate Central).*

Most Co2s derive from burning fossil fuels.

The policy problem: Reducing CO2s

Global policy coordination has despite 30 years of negotiations and inquiries only come up with a soft goal: a) no Co2s increase from 2020; 30% reduction in Co2s up to 2030; climate neutral energy from 2075. But no concrete measure have yet been taken, as there is little agreement on size of emissions decreases.

Since the emissions are linked with energy, the fear is that reductions of Co2S will hurt economic growth or socio-economic development. Poor countries argue that rich countries should reduce .more or pay compensation. There was talg about a 100 billion $ fund at the Paris meeting in 2016, but it has not been set up yet.

Consider the relationship between GDP and energy over time (Figure 2).

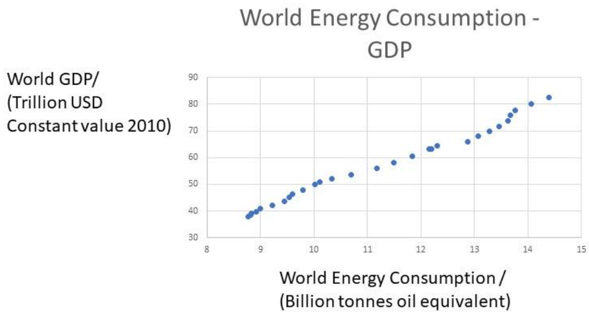

Figure 2. *Link Energy Consumption – GDP. (OECD, World Bank)*

As countries now plan for more of energy, they rely upon renewables. However, the renewables are looked up as supplement or additions to existing energy profile and may not reduce the burning of fossil fuels much.

Let us look at Table 1 that outlines an energy transformation from coal to renewables. The numbers shown represent the number of world record size solar plants each nation would need to replace their entire coal plant setup. As a benchmark, the Bhadla Solar Park near Jodhpur with an output of 2245 MW has been used.

Table 1. *Number of solar plants needed to replace coal by country*

Country	Number of plants
Asia	
China	475
India	100
Japan	28
South Korea	18
Turkey	9
Americas	
United States	106
Colombia	1
Europe	
Germany	32
Russia	30
Africa	
South Africa	14

Table 1 shows the "big sinners" in this global game of climate change. What is a *just* energy transformation? Should the five biggest coal polluters simply remove their plants without compensation? Would this be realistic for China, India and Russia? Under what conditions would developing countries accept such proposals, which would cut Co2 emissions considerably? Perhaps demand that rich countries do the same and pay for the costs of the poor countries? Maybe the US and the EU adduce reservations? Then China may do the same. It's numbers are definitely a Hugh non-excludability for Earth. Surely it is feasible for Japan, South Korea and Germany, the current U.S. administration has reneged.

Dismantle coal power plants? But replacements? Renewables is one alternative as so is natural gas with lower Co2s than coal. Cost? Who pays? Perhaps a colonial compensation?

A common pool regime (CPR)

There are a few ways to cut down Co2 emissions such as carbon capture ex ante production or ecological post sequestration. Whatever policy method one may usd:

1) carbon tax
2) emissions market
3) carbon capture and storage
4) voluntary reductions
5) increase in energy efficiency,

One would still need a global accord about ths distribution of benefits and costs. If China should close it's coal business, then the rest of the world would benefit but will it pay compensation? One could argue that energy transformation is good for Chinese people. Can states be "forced" to give up coal by other countries in a CPR? Hardly. The CPR of the UN - - will not accomplish global governance of climate change due to the oppertunism with guile with players in this ocean PD game. The long series of global reunions serve like a Potemkin village to hide that only energy change can reduce emissions. Most countries plan for huge increase in energy consumption the coming decadeS.

Policy confusion

The EU says it will burn no fossil fuels and thus have zero emissions by 2050. Not realistic and too late. Oil and gas will be consumed for the entire century. It is coal that must be stopped as energy source - both stone and wood coal. Germany has declared that it will have closed it's many coal power plants by 2038 - again very late. Will all of Eastern Europe do the same?

Germany now phases out all nuclear reactors by 2022, which is contrary to the EU ambition to become carbon neutral. Will France do the same with some it's many reactors? Then, on what power resources shall the might of EU rest upon? Renewables? Not enough! Biomass? Coal again.

It is remarkable that the use of market mechanisms – carbon taxes and carbon trading - has not succeeded in stopping the rise of CO2 concentration in the atmosphere. Although several countries employ these mechanisms, they simply do not work according to theory, some scholars arguing that they constitute failures (Böhm & Dhabi, 2009). Neither have the presented attempts for carbon capture been successful on a global scale. What is urgent is that national emissions of greenhouse gases are reduced, as was agreed upon in the Paris agreement. It is peculiar that not even the European union has been able to reach a unified position regarding the policy against CO2 emissions.

The road into climate change

It is true that some countries have finally begun adapting to climate change. One may mention the transformation in the automobile sector with the coming of EVs as well as the search for more efficient batteries. However, the Keeling curve is still rising, because energy consumption is still dominated by the burning of fossil fuels.

Let us assume that the next decade will be "business as usual", in the sense that global governmental coordination does not deliver and that adaptation remains rather weak with few exceptions. Then we are on the road to the following global warming scenario.

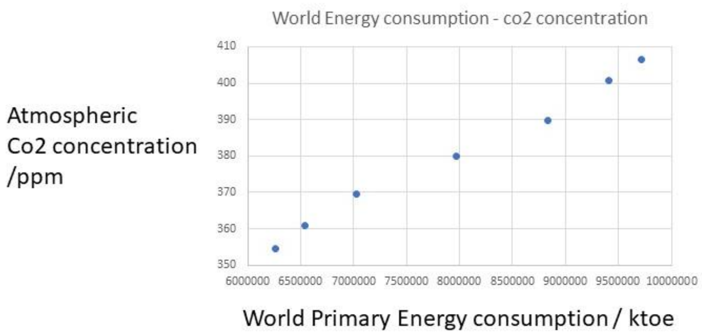

Figure 3. *Link Energy Consumption – CO2 Concentration (IEA, ESRL).*

Figure 3 regresses atmospheric CO2 concentration on global energy consumption.

The fitted linear trendline is: Y=0,00001 * x + 267,51, R2=0,992. The next step is to regress temperature rise on CO2 concentration.

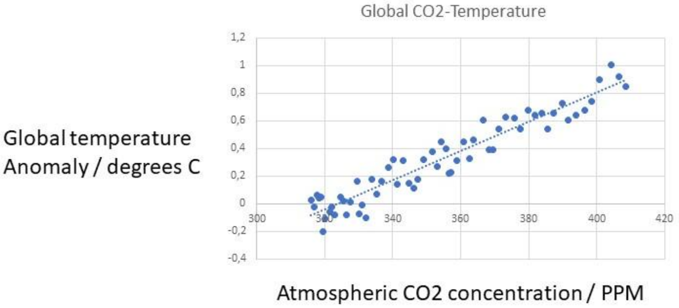

Figure 4. *Link CO2 concentration – Temperature Rise (ESRL, NASA)*

The shown trendline follows the equation:

$$Y = -3{,}4277 + 0{,}0106x$$

By combining these formula, we arrive at the following scenario:

Table 2. *Regression estimates for temperature rise based on energy consumption.*

Global Energy / btoe	CO2 concentration / PPM	Temperature rise / degrees C
16	430	1.1
18	450	1.3
20	470	1.5
22	490	1.7
24	510	2.0

The idea of global warming irreversibility implies that planet Earth will keep getting warmer year by year. There is no going back unless we turn to massive carbon capture. How fast it will rise depends primarily on energy consumption, but we may reach + 2 degrees already during this decade. As long as the world pours out gigantic emissions, the Keeling curve will keep rising. The idea of zero carbon emissions is a figment of imagination. What happens when we move towards 3 or 4 degrees is entirely unknown. The survival of advanced life is from now on threatened.

Conclusion

One may perhaps say that the history of mankind starting 400,000 years ago with the Cro Magnons leaving Africa has entered a new era: the global warming period. It will stick with all countries for as long as they continue this pattern of energy consumption. The underlying reason is the search for affluence (see figure 5).

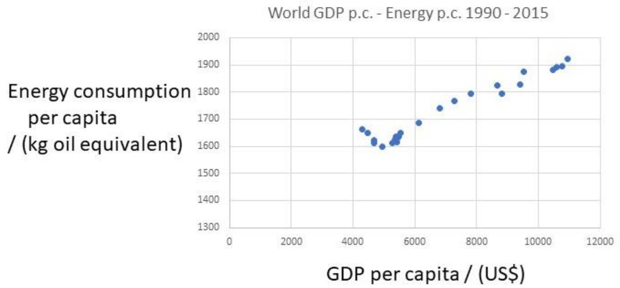

Figure 5. *Link Global GDP per capita – Energy Consumption per capita (World Bank, IEA).*

Some commentators have started talking about major wars as the result of climate change, but this is irrelevant. If the nations of the world fail to stop global warming, then what is the point of conducting global wars?

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16 Path to carbonization: The new silk road

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The political economy of Asian countries has focused upon one value the recent decades, namely economic growth and resulting affluence and cumulative wealth. It is a liberal economic miracle a la Hayek – the blessings of open economies, export orientation and market liberalization, i.e. laissez-faire. Despite all talk about market socialism, crony capitalism, state capitalism, South Asia, South East Asia as East Asia stand for much of capitalist dynamics today. As the greatly underestimated French economist J.B. Say stated: Supply creates demand, which entails that this part of the world has seen living standards markedly improved. Will the New Silk Road, projected by China and supported by countries concerned, bring affluence and wealth to the emerging market economics of Central Asia?

The Old Silk Road created wealth from China to Turkey, over *Kurdistan* by mean of slow trade. Now the gigantic plan to renew the Silk Road aims at fast trade like by mean of railroad and autostradas, besides the sea-link. The planners and governments concerned, all supporting the Chinese initiative, speak of a green road, an environmental friendly link from East to West. But could it be true?

The long land slice from Turkey to China over the countries of Turkistan, Iran and Pakistan is not often mentioned in debates about global warming and climate change as well as environmental threats. But in reality, it is a fossil fuel hotspot. Here we find several pipelines, enormous gas resources and an almost complete reliance upon fossil fuels, with much coal. Let us look at three of the largest nations: Turkey, Iran, Pakistan and Kazakhstan, all vital to the New Silk Road for success economically.

The basic model

To understand the real role that energy plays for the economy and CO2:s, we turn to the Kaya model [Retrieved from]. The basic theoretical effort to model the greenhouse gases, especially CO2:s, in terms of a so-called identity is the deterministic Kaya equation (Kaya & 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). To halt the growth of the GHG:s, of which CO2:s make up about 70 per cent, one must theorize the increase in CO2:s over time (longitudinally) and its variation among countries (cross-sectionally). As a matter of fact, CO2:s have very strong mundane conditions in human needs and social system prerequisites. Besides the breading of living species, like Homo sapiens for instance, energy consumption plays a major role. 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:

(E1) Kaya's identity projects future carbon emissions on changes in Population (in *billions*), economic activity as GDP per capita (in *thousands of $US(1990) / person year*), energy intensity in *Watt years / dollar*, and carbon intensity of energy as *Gton C as CO_2 per TeraWatt year*." [Retrieved from].

Concerning the equation (E 1), it may seem premature to speak of a law or identity that explains carbon emissions completely, as if the Kaya identity were a deterministic natural law. It will not explain all the variation, as there is bound to be other factors that impact, at least to some extent. Thus, it is more 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: $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_tX_t + u$

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. [Retrieved from].

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).

I make an empirical estimation of this probabilistic Kaya model with a *longitudinal* test for 1990-2014, i.e. World data 1990 - 2015:

$$\text{(E4) Ln CO2} = 0{,}62\text{*LN Population} + 1{,}28\text{*LN(GDP/Capita)} + 0{,}96\text{*LN(Energy/GDP)}; R2 = .90.$$

The close link in the Kaya model may be visualized in Figure 1.

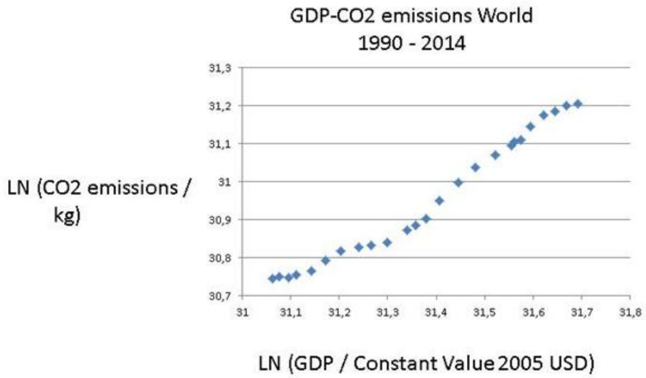

Figure 1. *Global GDP-CO2 link: y = 0,80x + 5,96; R² = 0,97 (N = 59)*

The findings show that total GHG:s or CO2:s go with larger total GDP, i.e. GDP per person * population. To make the dilemma of energy versus emissions even worse, we show in Figure 2 that GDP increase with the augmentation of energy per capita. This makes the turn to a sustainable economy (Sachs, 2015) unlikely, as nations plan for much more energy in the coming decades.

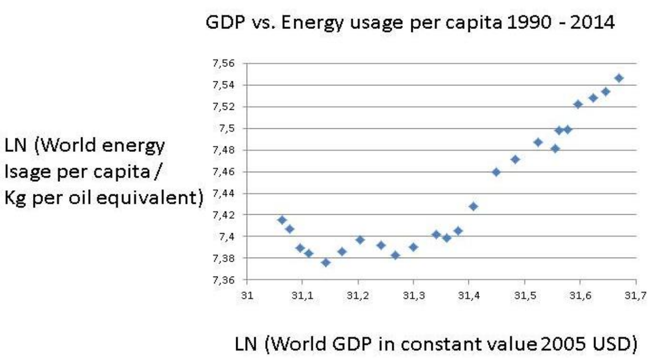

Figure 2. *GDP and energy per person 1990-2014*

Decarbonisation is the UNFCCC policy promise to undo these “dismal” links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy. Thus, the upward sloping curves must be reversed but still slope outward. Let us apply this model to three big countries along the new Silk Road, focussing upon affluence, energy, emissions and environment.

Turkey: Awakening giant

The political economy of Turkey has concentrated upon the political stability of the polity, bypassing its huge leap in affluence and economic development. As a matter of fact, Turkey has never been politically stable, neither today nor historically speaking.

The Ottoman Empire is an example of oriental despotism, namely *sultanismus*. It was plagued by the instability of harem politics. When the Young Turks set up modern Turkey, they failed to stabilize the country with a permanent constitution. Thus, there have been many changes to the first Basic Law of 1921 and the second in 1924. The many constitutional changes reflect not only *coup d’état* but also a weak tradition of the *Rechtsstaat*. Economically, things are entirely different, as Turkey is one of giants of the global economy, especially important with connections to the West and dominance in Turkestan.

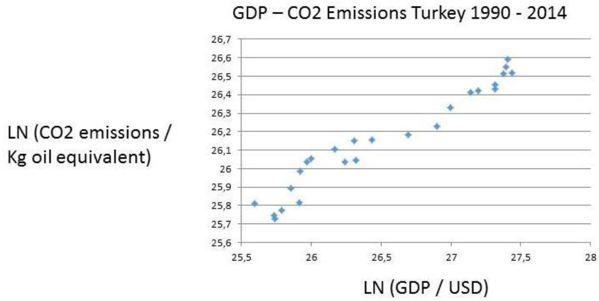

Figure 3. *Turkey: GDP – CO2: y = 0,41x, R^2 = 0,95*

Turkey has become a heavy-weight in the Asia Minor thanks to a rapid economic development of the country with huge population. Figure 3 supports this picture of Turkey as no longer a poor developing country. Comparing the picture for Turkey with that of "catch-up" nations, one may state that Turkey has the typical GDP-GHG link, despite lots of hydro power. Strong economic development is combined with heavy emissions increase. Since the world organisations – the UN, WB and IMF – opt for more of economic growth, one must ask whether emissions growth really can be halted. Figure 4 supports this picture of Turkey as a developed country.

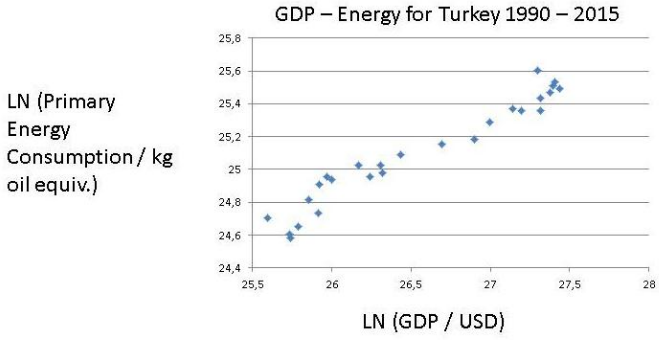

Figure 4. *Turkey: energy-GDP link*

Comparing the picture for Turkey with that of France and Germany, one may state that Turkey has the most typical curves. Strong economic development is combined with heavy emissions increase. Since the world organisations – the UN, WB and IMF – opt for more of economic growth, one must ask whether emissions growth really can be halted.

Turkey needs economic growth and lots of exports to pay for its energy needs, where oil and gas are imported from the East. Only hydro power is a large internal source of energy. Wind energy has become fashionable, but solar energy would be an ideal solution. Figure 4 shows how energy goes along with GDP growth. And Figure 5 displays the heavy reliance of Turkey on fossil fuels, mostly imported. Decarbonisation according to the COP21 Treaty implies that Turkey must change drastically, as it now depend at 90% on fossil fuels.

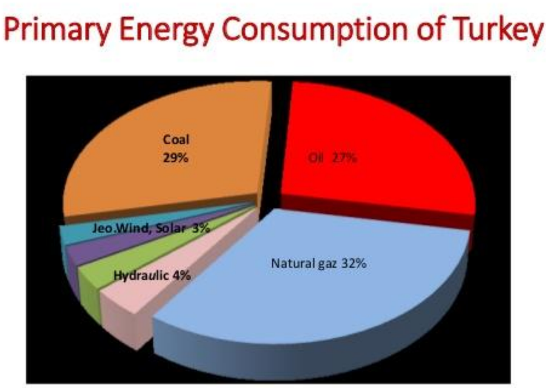

Figure 5. Energy mix in Turkey
Source: [Retrieved from].

Turkey is completely at odds with the goals of the COP21 Treaty. It must start fundamental energy transformation towards the use of renewables.

As a matter of fact, Turkey, Iran and Kazakhstan are responsible for huge CO2 emissions, we may say. As they pursue the "catch-up" strategy in relation to the advanced capitalist countries (Barro, 1991, Barro & Sala-i-Martin, 1992, 1995), they are not very eagre to take on the burden for global decarbonisation, especially if it hurts economic development. They would demand compensation from the promised Super Fund. Turkey has threatened to regene upon its COP21 promises.

Iran: Out of isolation

Countries may rely upon petroleum and gas mainly – see Iran. CO2 emissions have generally followed economic development in the giant carbon rich countries. In Iran though, there seems to be a planning out recently, perhaps due to the international sanctions against its economy. Iran has made considerable economic advances, despite international sanctions, but its CO2:s have also increased much (Figure 6).

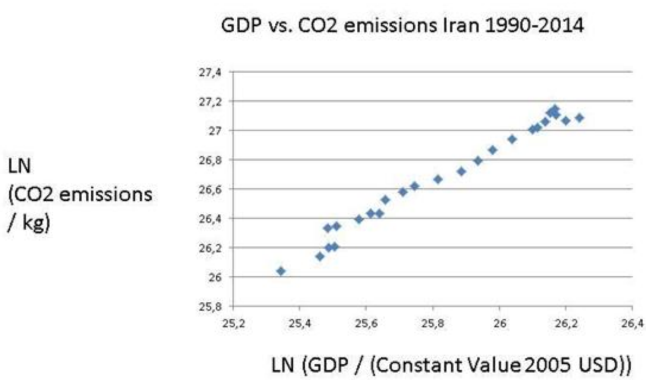

Figure 6. *Iran: GDP-CO2 link ($y = 1,2x - 4,91$; $R^2 = 0,98$)*

Iran is together with Russia and Qatar the largest owner of natural gas deposits, but also Turkmenistan and Ouzbekistan have enormous gas reserves. But despite using coal in very small amounts, its CO2 emissions are high. Natural gas pollute less than oil and coal, but if released unburned it is very dangerous as a greenhouse gas. Iran relies upon its enormous resources of gas and oil (Figure 7) to support the "take-off" of its economy (Rostow, 1960).

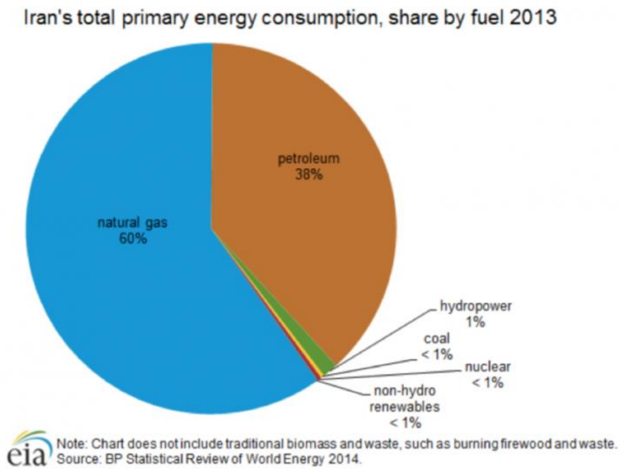

Figure 7. *Iran: Energy mix*

Iran is far from the goals of the COP21 Treaty, relying to 95% upon fossil fuels. It face difficulties with all three major objectives of the UNFCCC: GOAL I, II and III. Iran needs foreign exchange to pay for all its imports of goods and services. Using nuclear power at home and exporting more oil and gas would no doubt be profitable for the country. And it would also help Iran with the COP21 goals achievement. Solar power parks are the best solution.

Pakistan: Colossus on clay feet

The same upward trend for emissions holds for another major developing country with huge population, namely Pakistan (Figure 8). China relies much upon this country for its East-West plans. Pakistan needs high economic growth to feed its huge population, but economic development comes with Co2 emissions, despite much hydro power.

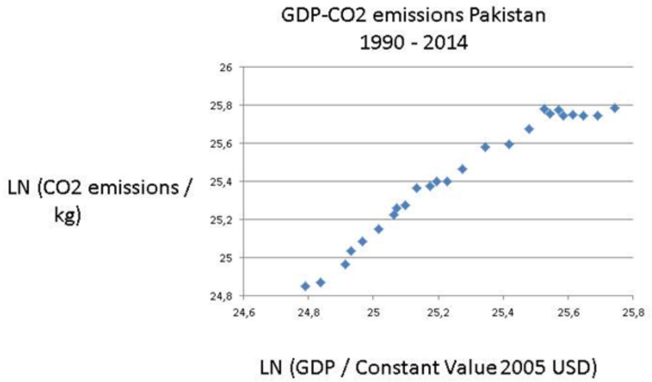

Figure 8. Pakistan GDP-CO2 link: y = 1,1x - 0,97; R^2 = 0,96

The amount of GO2 emissions is not so large for Pakistan. Viewed aggregately, Pakistan is reliant upon fossil fuels up to almost 70% (Figure 9). But its hydro power is impressive as its nuclear power.

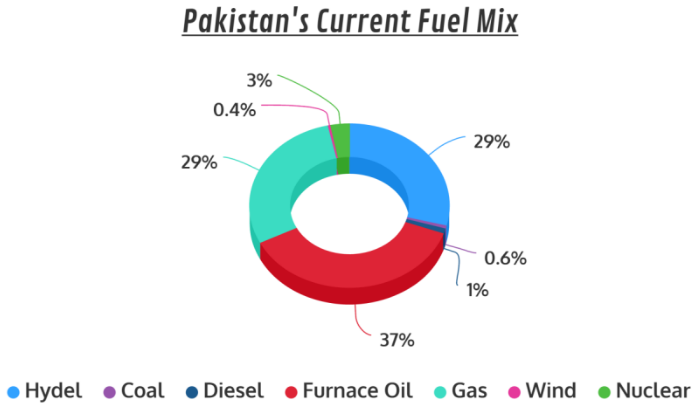

Figure 9. *Present energy mix in Pakistan*
Source: [Retrieved from].

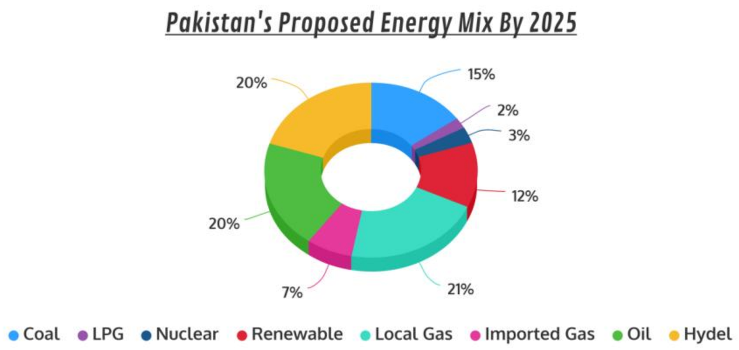

Figure 10. *Pakistan: Future energy mix*

As Figure 10 indicates, whether Pakistan aims to take the COP21 Goals seriously can be question, as coal is going to come in in a major supply way. Yet, Pakistan employs a considerable portion of hydropower – 13 per cent – and a minor portion of nuclear power, which is a positive.

Kazakhstan: Global power house in Turkestan

Here, we have a nation very much occupied with the catch-up strategy, as its exit from the Soviet Union worked like a "take-off" stage. It wants to copy the Asian miracles, moving to affluence in a few decades, using its immense fossil energy resources (Figure 11). But this picture is far from the obligations under the COP21 Treaty.

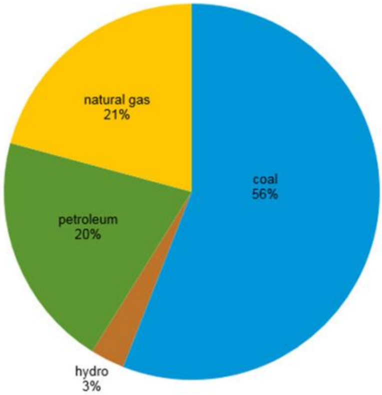

Figure 11. *Kazakhstan energy consumption by fuel, 2014.*

Kazakhstan's energy consumption leads to enormous emissions (Figure 12). The stunning economic development, including the great project of a modern Silk Roan from China to Germany through Kazakhstan implies that the CO21 goals cannot be accomplished here. Catch-up strategy and huge infrastructure trump climate change. Countries with no hydro power often display increasing trends for emissions. Consider this strategy and gas rich country in Asia – Figure 12.

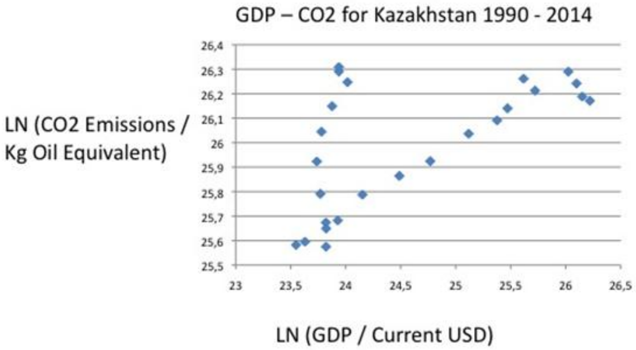

Figure 12. *Kazahkstan's link ($y = 0,17$; $R^2 = 0,38$)*

Kazahkstan employs its vast fossil fuel resources for energy consumpton besides exporting a lot. But it has to start energy transformation towards renewables.

The other "Khanates"

The New Silk Road will affect also the other so-caled Khanates. They are poor and small in population. Their energy situation is generaly one-sided. One the one hand, we have Ouzbekistan with fossil fuel dominance – see Figure13.

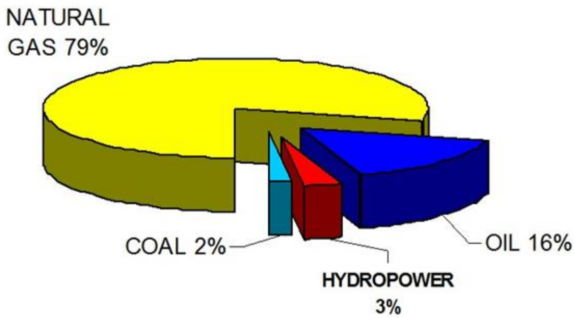

Figure 13. *Energy mix in Ouzbekistan*
Source: [Retrieved from].

Turkmenistan looks the same, drawing upon the huge gas resources in relation to the Caspain Sea. On the other hand, Tadjikistan and Kyrgistan has a completely different mix, relying mainly upon hydro power.

The silk road as carbon overloaded

Despite the rhetoric about the new green silk road connecting the East with the West, we find evidence of fossil fuel dominance in the social systems of the four key countries: Turkey, Iran, Pakistan and Kazakhstan. Thus, one may mention:

a) Energy with fossil fuels

b) Pipelines for oil and gas, train, road and infre structure development on a gigantic scale.

a) All countries analysed above are far away from the COP21 GOALS I, II and III.

We have noted the contribution to energy consumption by hydro power in Turkey, Tadjikistan and Pakistan. Pakistan also has nuclear power, whereas Turkkey possess wind power. But otherwise, it is all fossil fuels. Decarbonisation is necessary in the countries along the New Silk Road, as it is not a Green Road at all.

b) Pipelines and infrastructure

West Stream: An Intergovernmental Agreement was signed 1984 and natural gas imports started 1987. The Russia -Turkey Natural Gas Pipeline, which enters the country from the Malkoçlar on the Bulgarian border, following the route Hamitabat, Ambarlı, Istanbul, Izmit, Bursa and Eskişehir and reaches to Ankara, is 845 km long.

Blue Stream: Within the scope of the 25-year Natural Gas Purchase-Sale Agreement signed between BOTAŞ and Gazexport on December 15, 1997, natural gas is transported from the Russian Federation through a transit line under the Black Sea to Turkey. According to the agreement, 16 billion cubic meters of natural gas per year is supplied to Turkey.

Eastern Anatolia: A Natural Gas Purchase-Sale Agreement was signed between Iran and Turkey on 8 August 1996 in Tehran for the purpose of supplying 10 billion m3 per year of Iranian natural gas to Turkey via pipeline. The Eastern Anatolian Natural Gas Main Transmission Line.

Baku-Enzerum: The Baku-Tbilisi-Erzurum Natural Gas Pipeline, which aims to supply natural gas to be produced on the Shah Deniz field in the southern Caspian Sea region of Azerbaijan to Turkey, was realized under the Turkey-Azerbaijan Intergovernmental Agreement signed on 12 March 200. The BTE pipeline, 980 km long, uses the same corridor as the Baku-Tbilisi-Ceyhan Crude Oil Pipeline (BTC) in the territories of Azerbaijan and Georgia.

Turkey-Greece: The first phase of the South European Gas Ring, which was developed within the context of the European Union INOGATE (Interstate Oil and Gas Transport to Europe) Program, is the pipeline that will interconnect the Turkish and Greek natural gas systems and enable to transport natural gas to Greece from and/or through Turkey. This natural gas supply has been started in 2007. The Project has been planned to extend to Italy.

Trans-Anatolia: In order to meet the rising natural gas demand of Turkey, negotiations were held with the Azerbaijan Government and Shah Deniz Consortium, which has developed Shah Deniz field of Azerbaijan, and an agreement was signed on October 25, 2011 envisaging the supply of 6 billion m3 Azeri gas annually to Turkey starting from 2018. The first gas flow to Turkey via the pipeline is planned to be achieved in 2018. As for Europe, it is projected that gas supply will start at the year 2020.

Turkstream: In order to provide political support for the TurkStream Gas Pipeline Project and to determine the technical, economic and legal framework, The Intergovernmental Agreement between the Government of the Republic of Turkey and the Government of the Russian Federation on the TurkStream Gas Pipeline was signed in Istanbul in 2016. TurkStreeam Gas Pipeline Project is a new pipeline system running from Russia through Black Sea to receiving terminal on the Black Sea coast of Turkey.The project has an offshore section and an onshore section, which will be constructed to supply the natural gas to Turkey from Russia as well as to supply the Russian gas to Europe through the territory of Turkey. One of the lines in the onshore section will solely supply natural gas to Turkey. The second pipeline on the onshore section will supply gas to Europe.

Turkmenistan-China: Stretching from Turkmenistan to Xinjiang, the 3,666km pipeline was built before the new Silk Road project but forms the backbone of infrastructure links between the two countries. The pipeline is Chinese-built and cost US$7.3 billion.

Pakistan-China: The US$57 billion corridor to connect China's western provinces to the sea via Pakistan's Gwadar Port is the biggest project under the belt and road banner. It includes the China-Pakistan highway, railways, pipelines and power lines. One key project is the US$1.65 billion Karot hydropower plant in Pakistan, sponsored by China Three Gorges Corporation, reducing power shortages in Pakistan.

Iran-China: The first freight train from China arrived in Tehran, Iran, last year, making the 10,400km journey in 14 days. Tehran hopes the rail services will turn the country into a major Eurasian trade hub.

Kazakhstan-China: China plans to turn Khorgos in Xinjianginto a trade hub. Beijing aims to use the border city to link China with neighbouring Kazakhstan, and on to East Asia and Europe.

Summing Up: This small overview of plans and activities for the New Silk Road countries – Turkey, Iran, Pakistan and Kazakhstan – shows that it is not a question of a Green Road. On the contrary, fossil fuel dominated besides some hydro power.

Dangers and rational expectations

Central Asian countries now face the conditions for implementing the COP21 goals:

a) Halting the increase in CO2:s by 2020 – GOAL I;

b) Reducing CO2:s by some 30-40 per cent - GOAL II;

c) Complete or near total decarbonisation by 2075 – GOAL III.

Decarbonisation is the policy promise to undo these "dismal" links by making GDP and energy consumption rely upon carbon neutral energy resources, like modern renewables and atomic energy. Thus, the upward sloping CO2 curves must be reversed and start sloping downward (Stern, 2007, 2015). Thus, each nation and its government and private sector as well as third sector partners have to develop their specific policy to promote the goals of COP21: rapid decarbonisation.

The damages from climate change are visible in Asia now:

a) Land losses along the costs (Bangladesh, the Philippines);

b) Too high temperatures for men and women to work outside (India);

c) Food production decline (Pakistan, Sri Lanka);

d) Fish harvest decrease (China, Malaysia Pacific);

e) Droughts and starvation (Pakistan, India, Bangladesh);

f) Lack of fresh water supply (India);

g) Drying up of rivers (India, China);

h) Ocean acidification and species extinction (Australia);

i) Highly volatile climate with tremendous damages (Sri Lanka, Thailand, the Philippines, Malaysia);

j) Deforestation (Indonesia).

Among the dangers loom worse much outcomes, like the transformations of warm and cold currents in the oceans.

The only remedy: Renewables – solar plants ouarzazete size

Let us examine what this hoped for reduction of fossil fuels implies for the augmentation of renewable energy consumption, here solar power. The use of atomic power is highly contested, some countries closing reactors while others construct new and hopefully safer ones. I here bypass wind power and thermal power for the sake of simplicity in calculations. But wind power is highly relevant and would substitute for solar power. Geo-thermal power is country specific. Actually, every country has its specificities when it comes to energy resources and energy consumption. Consider now Table 1, using the giant solar power station in Morocco as the benchmark, it asks: 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 very big CO2 emissions?

Table 1. *Number of Ouarzazate type solar plants for decarbonisation GOAL II in 2030*

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Turkey	21	60	120
Iran	4 – 12	22	220
Kazakhstan	None	0	100
Pakistan	None	0	60

Sources: Paris 2015: Tracking country climate pledges. Carbon Brief, [Retrieved from].**;** EDGAR v 4.3.2, European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR), release version 4.3.2. http://edgar.jrc.ec.europe.eu, 2016 forthcoming; CO2 Emission Reduction With Solar. [Retrieved from].

Conclusion

The long land slice from Turkey to China over Turkestan and the Old Silk Road will most likely be developed into an energy hub for the New Silk Road. It is good news for these poor countries, but bad news for the global energy transformation that must come now, if we are to avoid Stephen Hawking's dire that climate change could become irreversible. Solar power parks are the solution for Turkey and Central Asia.

The need for decarbonisation all over world is a MUST to avoid the realisation of Stephen Hawking' warming about irreversible global warming. The key countries involved in the New Silk Road project should focus all technological efforts to move towards renewable energy and electrical vehicles. They are already fossil fuels dependent over 90 per cent.

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17 Approaches to climate change: Something is missing equation

Introduction

The COVID19 intermezzo was a short run chock that several states counteracted rapidly by forceful means. Now the infernal set of "tipping points" makes mankind fear climate change. These tipping points are in reality positive feedback loops reinforcing global warming—Hawking's irreversibility. Why will not governments fulfill their Paris agreement obligations? The interaction between humans and Nature is slowly changing. From mankind exploiting Nature for its own benefit, it now appears that Nature is posing lethal threats to humanity such as COVID-19 and global warming. The Corona virus threat acts on short term, while climate change is a long term challenge.

As nations start opening up their social systems, one may wonder what is next inside for Planet Earth after this terrible short term shock. The global warming threat is forever present, but the consequences may need long time periods to evolve. It is a matter of a slow moving disaster with potentially dismal ramifications for the global economy. Much depends on the strength and timeliness of positive feedbacks as well as the adaptability of mankind. The prediction of abrupt climate change as soon as 2030 or earlier is probably an exaggeration, so where do we stand today? Figure 1 illustrates the relative amounts of different greenhouse gases.

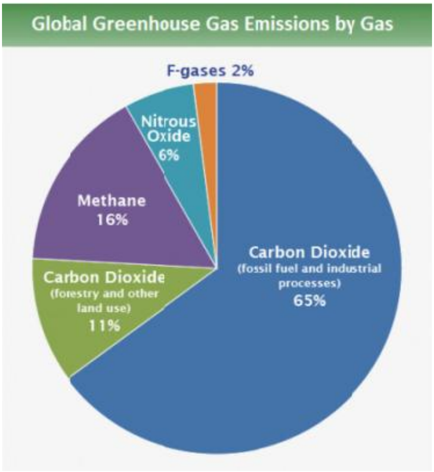

Figure 1. *Worldwide greenhouse gases by substance (EPA)*

As CO2 (Carbon Dioxide) and CH4 (Methane) constitute the bulk of wolrdwide GHG emissions, we will concentrate on finding models for their numbers. The omnipresence of CO2 and CH4. The baseline fact about carbon dioxide and methane can be stated in a simple chart, depicting developments after the Second World War.

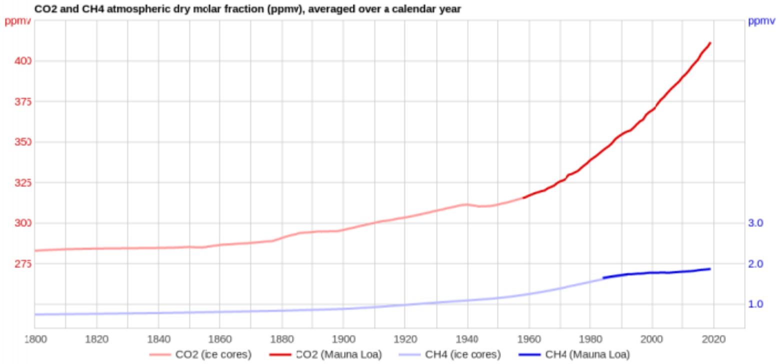

Figure 2. *CO2 and CH4 concentration (sealevel)*

CO2 Concentration

It should be considered somewhat surprising that the Keeling curve has risen also during the COVID 19 pandemic, reaching a value of 418 ppm (). However, it should be remembered that greenhouse gases originate from various human activities and all of them have not been shut down. There is an ongoing revolution in transportation with the coming of EV (Electrical Vehicles), but the majority of the world's population can still not afford this expensive mode of transport. Moreover, housing, heating, electricity and agriculture continue, emitting CO2. Figure 3 shows greenhouse gases divided by sector.

The impact of carbon dioxide is primarily an increase in temperature, indirectly causing a number of outcomes, and reinforcing global warming by means of positive feedback loops. Over time, the relationship between CO2 concentration in the atmosphere and temperature increase can be modeled as a linear function as follows:

Temperature Increase / degrees C=-3.3 + 0.0103*CO2/ppm (1)

Given the current level of CO2 of 418 ppm, global surface temperature has increased by 1 degree C. If and when we reach 500 ppm, the temperature rise would according to the model become higher than the 1.5 degree max target of the 2015 Paris agreement (1.8 degrees). The abrupt theory of climate change implies that we will reach 500 ppm as soon as within ten years. Yet, global warming is a slow process, albeit Hawking irreversible. Besides CO2 emissons, much more attention must be paid to the thawing permafrost in the Northern Hemisphere.

CH4 Emissions

When emissions of CH4 are added to the global warming picture, things become even worse. Methane emissions originate almost exclusively from agriculture and natural gas production.

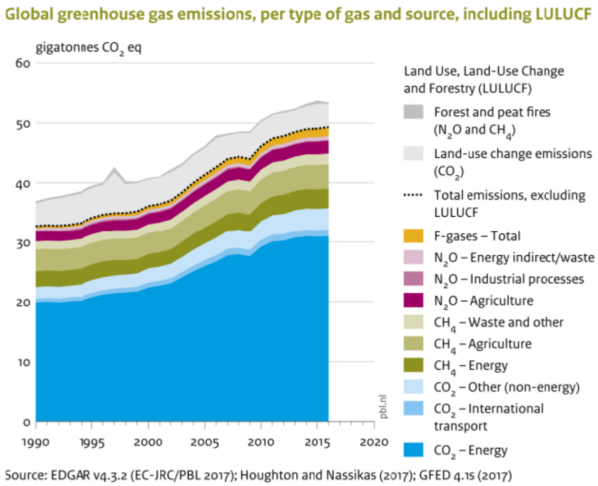

Figure 3. *2017 Worldwide greenhouse gas emissions by gas and sector (PBL)*

In the future, CH4 may come from the tundra where the permafrost is now thawing. This trend is extremely dangerous and volatile, as the amount of carbon stored in the Northern Hemisphere underneath the permafrost is excessively huge. When we model the relationship between CH4 and temperature increase, we get the following linear regression line:

Temperature Increase / degrees C=-1.16 + 0.00094*CH4 concentration/ppb (2)

The logic of state action

The governments of the nations of the world have delayed action on climate change for more than 30 years. The next IPCC conference has now been postponed until late 2021. What interest do governments pursue in climate change policy making?

First, one needs to focus on which states are responsible for the most emissions. Table 1 and Table 2 present the 10 biggest polluters of CO2 and CH4, respectively, the "Mega Polluters".

Table 1. *10 World Leading Emitters of CO2*

Country	Emissions / billion tonnes	Share / %
China	9.4	27.8
United States	5.2	15.2
India	2.5	7.3
Russia	1.5	4.6
Japan	1.1	3.4
Germany	0.7	2.1
South Korea	0.7	2.1
Iran	0.7	1.9
Saudi Arabia	0.6	1.7
Canada	0.6	1.6
	23	67.7

Table 1. *10 Leading emitters of CH4*

Country	Emissions / gt CO2 equivalent	Share / %
China	1.75	21.87
India	0.64	7.94
Russia	0.55	6.81
United States	0.50	6.24
Brazil	0.48	5.95
Indonesia	0.22	2.79
Pakistan	0.16	1.98
Australia	0.13	1.57
Iran	0.12	1.51
Mexico	0.12	1.46
	4.66	57.11

Given that only 10 countries produce more than half of the world's greenhouse gases, it is a remarkable fact that small countries aiming at zero emissions don't matter at all. Furthermore, the basic interests of states have been theorized in two contrary approaches: on the one hand, *realpolitik* versus *moralism*. The first of these focuses on state power and its maximization in an environment of anarchy, while the second rejects state egoism, especially denouncing war, arguing that states are bound by basic model principles of humanity: *pacta sunt servanda*, speak the truth, never attack unless attacked, and pay compensation for damages

The environmental movement would like to add *sustainability* to these basic norms. Recently, moralism has made advances in public international law, e.g., the International Court of Justice, but realpolitik remains dominant in international relations. Thus, governments can sign declarations for environmental policy purely for tactical reasons without ever implementing them. When looking at the lists of mega-polluters in the global climate change game with prisoners dilemma (PD) theory, one understands why climate policy making has failed. There is no organization or body with the authority to force China, India and the United

States to leave the path of fossil fuels. The weakness of moralism in public international law is the lack of enforceability. The EU promising carbon neutrality by 2050 can not force Germany to stop its huge consumption of coal.

Conclusion

The fear of abrupt climate change is exaggerated, as global warming involves a low but steady temperature increase. It will hit mankind through multiple positive feedback loops, but they all require time before their impact reaches their maximum. So many of the human-experienced consequences of climate change, including possible changes through global ocean currents, the melting of the North Pole, Greenland and Antarctica, will be slow. On the other hand, nobody knows what temperature rises mankind can support. How soon global warming will be lethal for humans depends also on what responses Governments take in the form of reducing coal power in particular, subsidizing electrical vehicles, protecting all kinds of forests and setting up large carbon capture facilities.

Apparently, increases in temperature in the Anthropocenic period have reached a value of 1 degree Celsius, caused by emissions of both CO_2 and CH_4. Carbon dioxide seem to be more important than CH_4 as of now, but that my change in the coming decade. When global warming passes 2 degrees, a number of tipping points will be triggered. Nobody knows how large temperature increase mankind can support in different parts of the world. People will migrate. When administrations really start to reduce their Mount Everest of carbon dioxide emissions, they have a long way to go before carbon neutrality or even carbon negativity can be accomplished, but what to do if methane emissions start increasing rapidly?

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18 The global contradiction of the 21rst century

Introduction

Economists and environmentalists alike underline that there is in principle no contradiction between economic growth on the one hand and preservation of the environment on the other hand. And they go on to offer many examples of innovations that foster both growth and ecology concerns. Thus, Singapore for instance has spearheaded the development towards economic growth that is also environmentally sustainable. And an entire city in China has been built upon the use of renewable sun energy. Moreover, almost all carmakers have planned for the construction of electricity or hydrogen cars. And many urban sites employ so-called green buses.

This coherence between economic growth and environmental sustainability holds at the micro level in the economy, encompassing lots of interesting and promising projects. However, at the macro level, especially at the global level, matters entirely different, as economic activity in general consumes lots of energy, which results in a constantly increasing emission of greenhouse gases. This global contradiction between economic growth and ecological sustainability, both valued by many people, will most probably be the major headache of the 21rst century, because there is a limit to the increase in CO2 equivalent emissions as far as climate change is concerned. Too much global warming may change the basic living conditions on the planet Earth.

The aim of this short research note is to pin down exactly these macro relationships between economic activity, energy consumption and greenhouse gases, as they hold for the globe today when measured at total levels.

The relevance of economic growth

Economists and politicians emphasize the need for balanced growth on many occasions. Zero economic growth has been pledged by a small group of people, talking about the global limits to growth. They are often rebutted by the argument that growth and environment do not necessarily collide. This is true – at the micro level.

One understands the quest of e.g. France for economic growth, having experienced the misfortunes that a long period of almost zero growth leads to: budget cuts, loss of public service employees, too little investments, reductions in welfare spending, cutting back on culture projects, etc.

Development theory provides a key role to economic growth for the ambition of the Third World to catch-up with the First World. The recent surge in economic growth in for instance the new economic giant countries is looked upon with envy by the European Union (Table 1).

Table 1. *Economic affluence in the 21rst Century (LN)*

Year	2000	2003	2006	2009	2013
Euro area	10,29676	10,31826	10,37374	10,34777	10,36743
European Union	10,15841	10,19739	10,26617	10,24443	10,27151
Brazil	8,390884	8,400867	8,491793	8,570001	8,669578
India	6,359949	6,471810	6,681178	6,85408	7,060473
China	7,023098	7,265115	7,570294	7,867549	8,18406

As is well-known, the GDP measures on income or production does not take environmental costs into account. Instead, polluting industries like the airline business, shipping and the car sector contribute considerably to the GDP. It has been argued that the GDP standard indicator should be revised to include the subtraction of ecology costs.

Now, the generation of total income or production for a year comes with the emission of greenhouse gases. Diagram 1 portrays the close connection between GDP and total emission, using LN numbers for most recently available data.

Diagram 1. Total emissions and GDP

Equation : $LNGDP - LNGHG$

Total : $y = 0.81x$ $R^2 = 0.708$

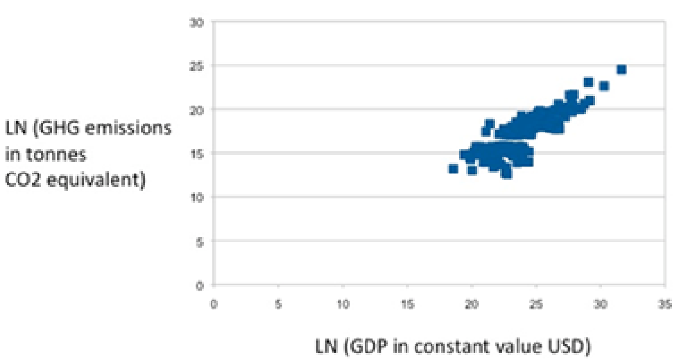

Figure 1. *Total emissions and GDP*

Note: GDP vs. Greenhouse emissions for 158 countries in 2011.

Diagram 1 shows that on the global macro level, the variation in economic development has strong implications for the emission of all kinds of greenhouse gases: the richer and larger a country economy, the more emissions it releases. This finding is, of course, the rationale for the argument that we need another kind of economic growth that builds upon carbon neutral technology. This is no doubt feasible in theory, but in practice we are stuck with the fossil fuel economy. And the destruction of forests and fresh water sources continue.

At global reunions among the politicians and experts, there is much talk about the emissions per capita. Developing countries underline that they tend to display lower emissions per capita than advanced economies. Is this true? Diagram 2 suggets an answer to the question of the distribution of the total greenhouse gases, which is a most policy relevant issue.

Diagram 2. Emissions per capita and GDP per capita

Equation : $LNGDP/CAP - LNGHG/CAP$

Total : $y = 0.52x$ $R^2 = 0.370$

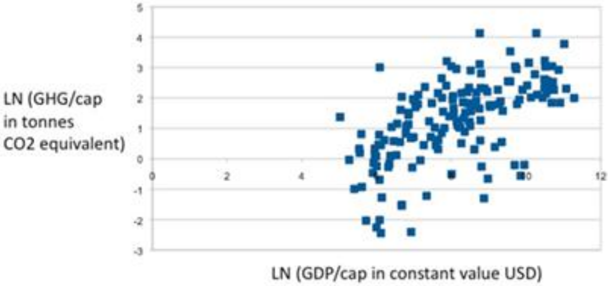

Figure 2. *Emissions per capita and GDP per capita*
Note: GDP/capita vs. Greenhouse gas (GHG) emissions / capita for 158 countries in 2011.

The finding, however, suggests strongly that emissions per capita is only weakly associated with GDP per capita. Thus, a few rich countries have rather low emissions, whereas some developing countries have substantial emissions per person. Thus, a global policy for ecological sustainability with regard to emissions control must be the responsibility of all countries on the globe, all people being concerned. It is true that a few rich countries have very high emission per capita (Gulf States, Australia, the US), but most of the emissions originate in the very populous countries in the world, especially in Asia.

Economic development can, I emphasize again, be environmental friendly. Many micro projects have reduced carbon emissions and yet delivered goods and services more efficiently. However, what counts at the macro level is the overall addition and subtractions. Take the example for Singapore that is well aware of the energy-environmental conundrum. Although it must be admitted that Singapore is doing many advanced projects to promote ecological sustainability, it should be pointed out that it is a big hub for air traffic and see shipping, which both result in greenhouse gases. In addition, Singapore has coal fired power stations and consumer huge amounts of electricity (water cleaning, waste treatment, air conditioning in almost all housing and public buildings).

The same contradictory finding applies to the UAE where lots of investments are done in ecologically friendly projects. But the fact remains that CO2 emissions per capita here are the largest in the world, like Qatar.

To understand the close link between total GDP and total emissions one needs to look at global energy consumption.

Energy consumption

Economic activity in all forms consumes directly or indirectly huge amounts of energy. This leads to the emission of greenhouse gases, directly or indirectly. To take a somewhat drastic example: the rapid increase in consumption of meat energy has resulted in an enormous growth of the number of cows in the world, which produce methane that is very conducive to climate change and global warming. Diagram 3 shows the close connection between total GDP and total emission today.

Diagram 3. GDP and energy consumption

$$LNGDP - LNEnergyConsumption$$

$$y = 0.71x \qquad R^2 = 0.695$$

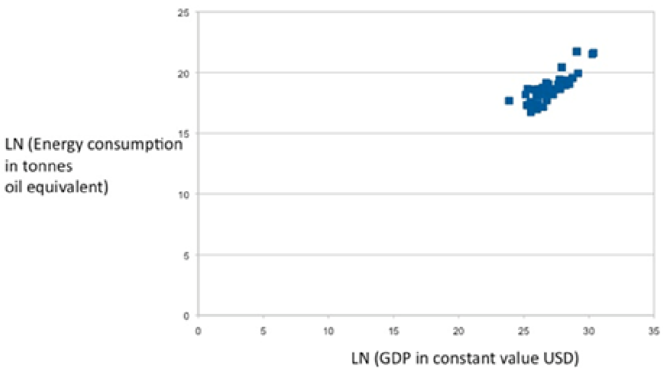

Figure 3. *GDP and energy consumption*

It is also the case that rich countries consume more energy per person than poor countries, as higher levels of affluence require more energy – in general. Again, the situation is paradoxical, as rich countries can invest in environment friendly technology but they also consume more energy for upholding their lifestyle. Diagram 4 has the finding.

Diagram 4. GDP per capita – emissions per capita

$$LNGDP / CAP - LNEnergyconsumption / CAP$$

$$y = 0.47x \qquad R^2 = 0.641$$

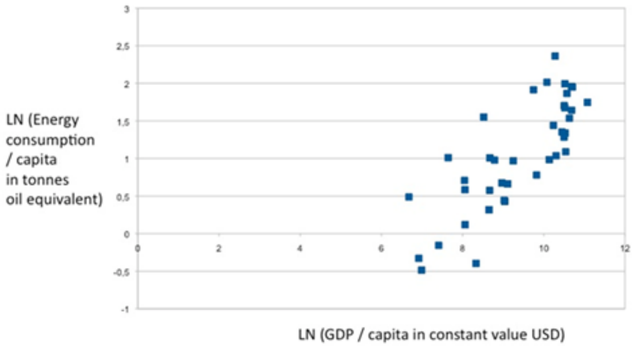

Figure 4. *GDP per capita – emissions per capita*

More affluent or luxury life styles are exhibited not only in bigger and stronger cars but also in more heating and air conditioning. Electricity is much needed in affluent countries. If is not to be produced by nuclear energy, as in Germany, a country mat actually rely more upon coal fired power stations with massive amounts of imports of coal from developing countries, like Equator and Colombia with dismal ecological effect.

Conclusion

Global ecological sustainability is not enhanced as long as total carbon equivalent emission increase, i.e. augments sharply year in and year out in reality. Two factors increasing greenhouse gases on the macro or global level are world population and economic activity:

Equation I:
Total greenhouse gases =

$$LNGHG = 0.520 * LNGDP + 0.477 * LNPop$$

$$R^2 = 0.76$$

This equation models the global situation today. One can imagine what happens to total greenhouse gases emissions and ecological sustainability when the world population reaches 9 billion and GDP doubles.

The major factor behind the increases year by year in greenhouse gases by some 3 per cent, besides many promising innovations, is the constantly augmenting need for energy. Other factors matter too, it is true, like the cutting or burning down of foreats and the acidification of the seas and oceans. We look at the following equations finally:

Equation II.

$$LNEnergy = 0.477 * LNPop + 0.43 * LNGDP$$

$$R^2 = 0.88$$

Again, energy predictions for the next coming two decades from Energy Information Administration (EIA) mirror the projected growth in world population and the optimistic scenario for economic production or economic growth rates. I believe the energy factor is the central one, with support from the following equation:

Equation III.

$$LNGHG = 1.0109 * LNEnergy - 0.133 * LNPop + 0.1052 * LNGDP$$

$$R^2 = 0.95$$

The G20 group of states and governments need to do something to promote the use of energy from renewable resources. As they represent almost 60 per cent of global country population, the G20 could embark upon an ecologically sustainable energy policy without either free riding or massive transactions, which have plagued the UN efforts thus far. Changing energy patterns is the only realistic option, as the quest for economic growth is unstoppable.

19 Global warming: Opportunism and defection

Introduction

In so far as economists participate in the debate on global warming, they tend to approach climate change in terms of the associated costs. Various models (Nordhaus, 2016) have been launched since Nicolas Stern offered his review (Stern, 2006). We are very skeptical about these economic models, as they are overly sensitive to assumptions. If worse comes to worst and there are many human casualties from the effects of climate change e.g. from floods or malnutrition, how can the cost of a life be assessed?

Stern suggested a the few key quantities that have figured prominently in the United Nations Framework Convention on Climate Change (UNFCCC): "The current level or stock of greenhouse gases in the atmosphere is equivalent to around 430 parts per million (ppm) CO2, compared with only 280 ppm before the Industrial Revolution. These concentrations have already caused the world to warm by more than half a degree Celsius and will lead to at least a further half degree warming over the next few decades, because of the inertia in the climate system.

Even if the annual flow of emissions did not increase beyond today's rate, the stock of greenhouse gases in the atmosphere would reach double pre-industrial levels by 2050 – that is 550 ppm CO2 equivalents –and would continue growing thereafter. But the annual flow of emissions is accelerating, as fastgrowing economies invest in high-carbon infrastructure and as demand for energy and transport increases around the world. The level of 550 ppm CO2 could be reached as early as 2035. At this level there is at least a 77 % chance – and perhaps up to a 99 % chance, depending on the climate model used –of a global average temperature rise exceeding 2 degrees centigrade" (Stern, 2006). Stern speculated a lot on the conversion from CO2 emissions to rises in temperature.

"Developed countries in lower altitudes will be more vulnerable – for example, water availability and crop yields in Southern Europe are expected to decline by 20 % with a 2 degrees increase in global temperatures. Regions where water is already scarce will face serious difficulties and growing costs" (Stern, 2006).

What are the fundamentals of these speculations in numbers? Many people around the world are of the belief that the United Nations are going to succeed in limiting temperature rise to 1.5 / 2 degrees centigrade. This was the stated goal in the Parisagreement from 2015, where Machiavellian French Minister Laurent Fabius managed to reach consensus among more than 190 countries by promising an energy transformation fund of 100 billion USD annually. Although some money have been invested in new technology, the resources have not been forthcoming. In reality, there is a dire need for a new energy supply structure among the heaviest polluters.

Table 1. *Top 20 Energy consuming, CO2 emitting, and coal power producing nations of the world (Enerdata 2019, Crippa et.al. 2019, Global Energy Monitor 2020)*

Top 20 Energy Consuming Countries 2018	Top 20 CO2 Emitting Countries 2018	Top 20 producers of coal energy 2019
China	China	China
United States	United States	United States
India	India	India
Russia	Russia	Russia
Japan	Japan	Japan
South Korea	Germany	Germany
Germany	Iran	South Africa
Canada	South Korea	South Korea
Brazil	Saudi Arabia	Indonesia
Iran	Canada	Poland
Indonesia	Indonesia	Australia
France	Brazil	Ukraine
Saudi Arabia	Mexico	Turkey
Mexico	South Africa	Vietnam
United Kingdom	Turkey	Taiwan
Nigeria	Australia	Malaysia
Italy	United Kingdom	Kazakhstan
Turkey	Italy	Spain
Thailand	Poland	United Kingdom
South Africa	France	Philippines
Share of World: 75.2 %	Share of World: 78.5 %	Share of World: 93,8 %

Fundamentals of the number exercise

Let us look at present trends, not likely to change very much in the near future. Regression line for the experimental relationship Energy consumption and CO2:

CO2 concentration / ppm = 267.5 + 10(World Energy Consumption / btoe)* (1)

And moreover, CO2 emissions have been estimated raise temperatures as follows:

Temperature Increase/(degrees centigrade) = -3.4 + 0.0106(CO2 conc. / ppm)* (2)

Employing these two regression equations Planet Earth would be in the situation in Table 3.

Table 2. *Temperature Increase Scenarios based on Global Energy Projections.*

Global Energy / btoe	CO2 concentration /PPM	Temperature rise / degrees C
16	430	1.1
18	450	1.3
20	470	1.5
22	490	1.7
24	510	2.0

According to Stern, the age of global warming would evolve around levels between 410 and 550 ppm. In terms of temperature rise, this would mean a span of 0.9 to 2.4 degrees. When emissions from methane and other gases are included, the World will be close to 3 degrees warmer. How could the Paris agreement limit the employment of fossil fuels in countries around the World? As great philosopher Hobbes said:

"Covenants, without the sword, are but words and of no strength to secure a man at all" (Hobbes, 2012) Economist George Tyler recently informed about gigantic plans for new coal-fired power stations: "…. 16 nations – including Egypt, Mozambique, Papua New Guinea, the United Arab Emirates and Nigeria – are planning their first installations . … Japan has plans for as many as 22 new coal-fired power plants over the next five years" (Tyler, 2020).

War

One sometimes meets the accusation that CLIMATE AFFIRMERS claim that global warming leads to war between states. In fact, global warming is conducive to social unrest and political chaos when the effects are widely felt from worsening life conditions. States may come to oppose each on open Access resources like water from rivers that cross multiple nations. Water scarcity looms ahead leading to drought, less hydro-electric power and starvation.

If some of the Great Powers would somehow collide in war, then it would quickly escalate to atomic warfare with the destruction of mankind. However, climate change poses a severe threat to human beings by itself.

Climate change conflicts could occur between minor powers concerning flows of migration or water access. Examples include the struggle about clashes regarding water from the Nile, the Euphrate and Tigris, the Indus and the Mekong, respectively. Climate change migrants will certainly appear in Bangladesh and in countries around the Sahara. A nuclear war is completely different, characterized by first mover advantage.

Conclusion

There is no support for a theory of global warming implying a definite span or a fixed carbon budget. Climate change is irreversible given the insatiable human demand for energy offered by fossil fuels and cement. For example, the United States plan to be the largest exporter of oil and gas by 2025 by means of the destructive technology of fracking. Renewables will grow, but neither matching the speed of population growth nor in line with the requirements of developing nations for a much bigger share of global affluence. Future demand of energy has been projected to evolve to 2035 according to Figure 1.

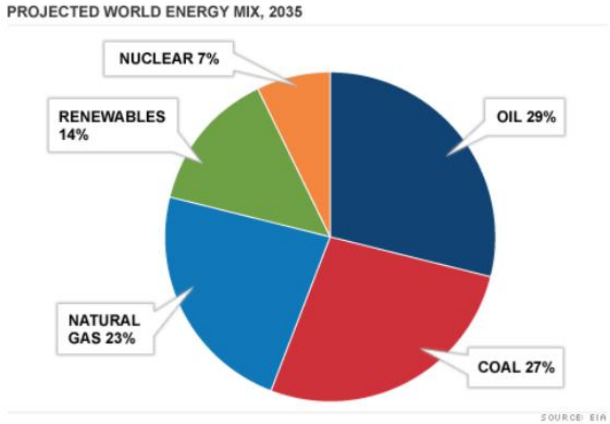

Figure 1. *Projected Energy Mix (EIA, 2011)*

It can be noted that both renewables and fossil fuels are expected to grow far beyond current levels. Further, if the leading powers of the world retain their hitherto business as usual position, fossil fuel will still supply the vast majority of energy for the planet. When each and every country in the mentioned set of great powers maximizes their intake of energy, all of them will fall into the energy trap of global warming with horrible consequences for mankind.

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20 The international system: Why the United Nations climate change approach has failed

Introduction

Global warming and its mechanisms are predominantly discussed in the context of climate science. However, the basic determinant of climate change can only be understood in the context of international relations. The large states of the world are the major polluters, keeping it up primarily in the quest for energy safety. Energy consumption has exploded since World War II and continues to rise as energy is necessary for economic growth. The high percentage of fossil energy use in these nations leads to untenable levels of CO_2 emissions.

The meetings of the United Nations Intergovernmental Panel on Climate Change (UN IPCC) process have for more than 30 years hidden the basic fact that countries whether rich or poor place a very high priority on access to energy, especially the use of fossil fuels. Thus, when they in the current situation are forced to expand renewable energy, they retain their supply of fossil energy sources. In some countries, emissions from coal-fired power plants were reduced in 2019, and will probably decrease more in the current year due to the effects of COVID-19. However, both China and India are planning to open new coal-fired plants. A country like China may decrease its share of fossil fuels by expanding their total energy consumption, but their coal consumption in absolute terms is still rising. The result of these policies is shown in figure 1.

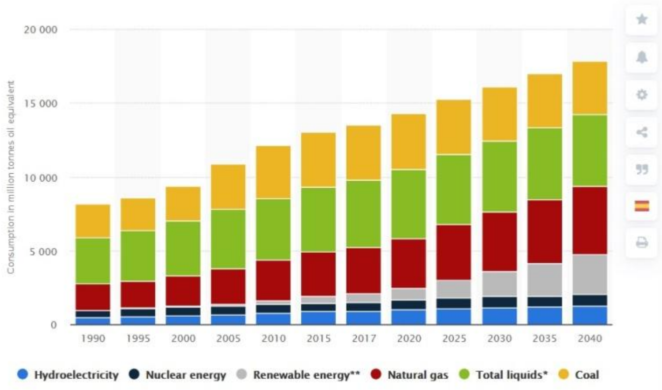

Figure 1. *World Energy Projections through 2050 (Statista)*

Similar projections have been published by other agencies such as the International Energy Agency (IEA, 2019) and the Energy Information Administration (EIA, 2020). Their predictions for energy consumption especially for coal power to 2050 are far from the objectives agreed upon in the 2015 Paris Agreement, where the aim was to reach a fossil fuel free planet by 2075 and reducing CO_2 emissions as soon as 2020.

Major energy consumers

Global political power is in the hands of some 20 states who in reality decide the fate of global climate. Table 1 shows the major energy consuming nations, the major CO_2 emitters, and major coal producers.

Table 1. *Top 20 Energy Consuming, CO_2 Emitting, and Coal Producing Nations in the World (Enerdata 2019, Crippa et.al. 2019, Energy Monitor 2019)*

Top 20 Energy Consuming Countries 2018	Top 20 CO_2 Emitting Countries 2018	Top 20 Producers of Coal Energy 2019
China	China	China
United States	United States	United States
India	India	India
Russia	Russia	Russia
Japan	Japan	Japan
South Korea	Germany	Germany
Germany	Iran	South Africa
Canada	South Korea	South Korea
Brazil	Saudi Arabia	Indonesia
Iran	Canada	Poland
Indonesia	Indonesia	Australia
France	Brazil	Ukraine
Saudi Arabia	Mexico	Turkey
Mexico	South Africa	Vietnam
United Kingdom	Turkey	Taiwan
Nigeria	Australia	Malaysia
Italy	United Kingdom	Kazakhstan
Turkey	Italy	Spain
Thailand	Poland	United Kingdom
South Africa	France	Philippines
Share of World: 75.2 %	Share of World: 78.5 %	Share of World: 93,8 %

Table 1 clearly shows how the countries are also the great "sinners" in exacerbating climate change. Through their political power, these nations also strongly influence how policies are implemented regarding climate change in the United Nations COP (Conference of the Parties) process, preferring soft mechanisms like carbon taxation or CO2 emissions trading (cap and trade) over legislation. Hitherto they have accepted to participate in the UN process including much valuable research, but they have blocked any commitment to do anything concrete or serious in terms of emission reduction measures besides applauding general objective as a post-modernist discourse. These countries could lower the burden on the planet's ecosystems by implementing transformative methods of energy which includes the end of the use of coal-fired power plants. However, they do not choose to do so. Why?

Energy – CO2 – temperature

Let us look at present trends, which are not likely to change very much in the near future. Regression line for the experimental relationship between energy consumption in btoe (billion tonnes of oil equivalent) and CO_2 in ppm (parts per million):

CO_2 concentration / ppm = 267.5 + 10*(World Energy Consumption / btoe) (1)

CO_2 emissions have been estimated to increase temperatures using the regression:

Temperature Increase/(degrees centigrade) = -3.4 + 0.0106*(CO_2 conc. / ppm) (2)

The regression results are shown in in table 2.

Table 2. *Temperature Increase Scenarios based on Global Energy Projections.*

Global Energy / btoe	CO_2 concentration / PPM	Temperature rise / degrees C
16	430	1.1
18	450	1.3
20	470	1.5
22	490	1.7
24	510	2.0

At present, the world consumes close to 15 billion tons of oil equivalent energy, translating to a 1-degree centigrade temperature increase. That is, energy is a major input to economic growth. Global energy demand is expected to grow by one-third between now and 2040 (EPIC, 2018). The current COVID-19 pandemic will certainly lead to a temporary reduction in energy use which leads to a decline in particulates contributing to pollution and climate change. By 2030, the Earth will experience temperature increases between 1.5 and 2 degrees Celsius, somehow considered as magical breaking points by experts like Nordhaus and Stern, who argue that the cost of global warming will become too high when these limits are exceeded (Stern, 2006; Nordhaus, 2013). In reality, the social and economic effects of global warming would be very much exacerbated when the rise is greater than 2 degrees Celsius (Stern, 2006).

Gedanken experiment – Replace coal by solar

One understands that some scholars have expressed great hopes for massive carbon capture projects, but it is more promising simply to shut down coal-fired power plants than to start putting CO_2 into the crust of the Earth. What would it take to replace coal energy by solar power? Table 3 presents how many world-class solar plants (Indian Bhodla solar plant used as a reference) some of the leading economies in the world would need to construct to replace their entire fleet of coal-fired power stations.

Table 3. *Solar Plants Required to Replace Coal Powered Plants (Global Energy Monitor)*

Country	Number of plants
Asia	
China	475
India	100
Japan	28
South Korea	18
Turkey	9
North America	

United States	106
Canada	6
Europe	
Germany	32
Russia	30
Africa	
South Africa	14

Table 3 reveals the world's major pollluters . If the principle that the "polluter pays", China, India. and United States should engage in energy transformation towards renewables. The problem is that especially India demand sizeable financial compensation for such measures, quoting the Indian Cabinet: "It said that India has been ambitious in its actions and has emphasized that developed countries should take lead in undertaking ambitious actions and fulfil their climate finance commitments of mobilising USD 100 billion per annum by 2020 and progressively and substantially scale up their financial support to inform Parties for future action through NDCs " (Economic Times 2020).

Conclusion

As a basic axiom in international relations among sovereign states act on the base of national interest, and energy is major part that forms the international relations. All states plan to increase their energy consumption during this century as attributed to its economic growth, socio-economic development, reduction of poverty, and military leverage. The UN attempts to create *normativity* by means of a global common pool regime for CO_2 emissions fail on the simple rule formulated by Hobbes: "Covenants, without the sword, are but words and of no strength to secure a man at all" (Hobbes, 2012) The lack of a global enforcing system will almost invariably lead to few or no results in the United Nations struggle for reducing emissions of greenhouse gases. Several scholars commenting on the COVID-19 regulations state that the time has come for a similar gigantic effort against CO_2 emissions (Rockström, 2020). However, this is not at all probable. Fighting the current COVID-19 pandemic is an internality, whereas reducing greenhouse gases is an externality. The Big Polluters require more energy, and the role of renewables in their energy systems is marginal. The level of CO_2 concentration has surprisingly not fallen during the COVID19 pandemic, because it remains in the atmosphere for some time. This limits the degrees of freedom of policy making for the International Society (Bull, 1977).

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21 Climate change responsibles

Introduction

The IEA predicts that the demand for energy and fossil fuels is not going to shrink in the coming decade, despite the rapid rate of innovation around the world. The need for energy is growing in developing countries providing more electric power to poor people.

It is true that the Covid lockdown has reduced energy supply by some 10 percent but this is temporary. Moreover, some of the big polluters use the slow process of international negotiations to avoid a radical climate change policy. Transaction costs skyrocket and promises made are reneged upon.

Now, global coordination is voluntary except for matters of war and peace and the IPCC has no control authority. International policy making suffers from much rivalry among Big Powers.

The logic of state action

The governments of the nations of the world have delayed action on climate change for more than 30 years. The next IPCC conference has n w been postponed until late 2021. What interests do governments pursue in climate change polic making?

First, one needs to focus on which states are responsible for the most emissions. Table 1, Table 2 and Table 3 present the 10 biggest polluters of CO2, CH4, and N20, respectively, the "Mega Polluters".

Table 1. *10 World Leading Emitters of CO2*

Country	Emissions / billion tonnes	Share / %
China	9.4	27.8
United States	5.2	15.2
India	2.5	7.3
Russia	1.5	4.6
Japan	1.1	3.4
Germany	0.7	2.1
South Korea	0.7	2.1
Iran	0.7	1.9
Saudi Arabia	0.6	1.7
Canada	0.6	1.6
Total	23	67.7

Table 2. *10 Leading emitters of CH4*

Country	Emissions / gt CO2 equivalent	Share / %
China	1.75	21.87
India	0.64	7.94
Russia	0.55	6.81
United States	0.50	6.24
Brazil	0.48	5.95
Indonesia	0.22	2.79
Pakistan	0.16	1.98
Australia	0.13	1.57
Iran	0.12	1.51
Mexico	0.12	1.46
Total	4.66	57.11

Table 3. *10 Leading emitters of N2O*

Country	Emissions / gt CO2 equivalent	Share / %
China	587.2	18.6
United States	288.9	9.2
India	239.8	7.6
Brazil	214.5	6.8
Indonesia	93.1	3.0
Sudan	85.0	2.7
Congo, Dem. Rep.	68.0	2.2
Russian Federation	65.2	2.1
Australia	54.2	1.7
Argentina	53.1	1.7
Total	1750	55.5

Given that only 10 countries produce more than half of the world's greenhouse gases, it is a remarkable fact that small countries aiming at zero emissions don't matter at all.

The costs of CO2 reduction

CO2 molecules stay in the atmosphere for very long time periods, so they must be removed very soon. Dreaming about negative carbon emissions would require the construction of enormous numbers of carbon-capture plants, or the replacement of coal-fired electricity by solar energy. Table 3 provides an estimate of how many World-class solar plants each of the leading polluters would have to introduce to replace all of their coal-fired capacity.

Table 4. *Number of Bhadla Solar Park Plants Required to Replace Coal Power by Country (Global Energy Monitor)*

Country	Number of plants
Asia	
China	475
India	100
Japan	28
South Korea	18
Turkey	9

North America	
United States	106
Colombia	1
Europe	
Germany	32
Russia	30
Africa	
South Africa	14

Intergovernmental coordination

For 30 years the UN has attempted global warming policy. The system of state interaction is much tilted toward national interests and power politics. There is a constant augmentation of military expenses year in and year out among the Big Powers, as if war was imminent. Some of the Big Polluters are engaged in proxy wars. Conflict is typical of the anarchical international interaction (Bull, 1979).

Yet there is also norms and normativity. An international society exists for cooperation on economics and trade, on the use of oceans and atmosphere etc, but there is no consensus on climate change so far. On the contrary, the poor countries want the rich countries to pay for energy transformation.

Public international law consists of three parts;

1) the acknowledgement and protection of states' rights in a reciprocal fashion;

2) the protection of the Planet Earth;

3) the protection of individual persons.

1) is strong whereas 2) and 3) is weak. Governments may appeal to the principle of non-interventions in internal affairs to avoid environmental attack. Yet, among the mega-polluters climate change has low priority. Somehow global warming is not very dangerous, at least not in the short term. Moreover, some of the big polluters use the slow process of international negotiations to avoid a radical climate change policy. Transaction costs skyrocket and promises made are reneged upon.

The IPCC has suffered from the lack of implementing agreements typical of international governance as well as the lukewarm participation of big polluters. Energy is vital for all countries, especially Big Powers even if derived from fossil fuels. Now, global coordination is voluntary except for matters of war and peace and the IPCC has no control competence. International policy making suffers from much rivalry among Big Powers.

International system or society

The system of states is much tiled toward national interestS and power politics. There is a constand augmentation of military expenses year in and year out among the Big Powers, as if war was immenent. Some of the Big Polluters are engaged in proxy wars. Conflict is typical of the anarchical international interaction (Bull, 1979).

Yet there is also norms and normativity. An international society exts for cooperation on economics and trade, on the use of oceanS and atmosphere etc. But not climate change so far. On the contrary, the poor countries want the rich countries to pay for energy transformation.

Furthermore, the basic interests of states have been theorized in two contrary approaches: on the one hand, realpolitik versus moralism. The first of these focuses on state power and its maximization in an environment of anarchy, while the second rejects state egoism, especially denouncing war, arguing that states are bound by basic model principles of humanity: pacta sunt servanda, speak the truth, never attack unless attacked, and pay compensation for damages.

The environmental movement would like to add sustainability to these basic norms. Recently, moralism has made advances in public international law, e.g., the International Court of Justice, but realpolitik remains dominant in international relations. Thus, governments can sign declarations for environmental policy purely for tactical reasons without ever implementing them.

When looking at the lists of mega-polluters in the global climate change game with Prisoners Dilemma (PD) theory, one understands why climate policy making has failed. There is no organization or body with the authority to force China, India and the United States to leave the path of fossil fuels. The weakness of moralism in public international law is the lack of enforceability.

The EU promising carbon neutrality by 2050 can not force Germany to stop its huge consumption of coal.

Conclusion

The fear of abrupt climate change is exaggerated, as global warming involves a low but steady temperature increase. It will hit mankind through multiple positive feedback loops, but they all require time before their impact reaches their maximum. So many of the human-experienced consequences of climate change, including possible changes through global ocean currents, the melting of the North Pole, Greenland and Antarctica, will be slow. On the other hand, nobody knows what temperature rises mankind can support. How soon global warming will be lethal for humans depends also on what responses Governments take in the form of reducing coal power in particular, subsidizing electrical vehicles, protecting all kinds of forests and setting up large carbon capture facilities.

Apparently, increases in temperature in the Anthropocenic period have reached a value of 1 degree Celsius, caused by emissions of both CO2 and CH4. Carbon dioxide seem to be more important than CH4 as of now, but that my change in the coming decade. When global warming passes 2 degrees, a number of tipping points will be triggered. Nobody knows how large temperature increase mankind can support in different parts of the world. People will migrate.

When administrations really start to reduce their Mount Everest of carbon dioxide emissions, they have a long way to go before carbon neutrality or even carbon negativity can be accomplished, but what to do if methane emissions start increasing rapidly?

In reality, international politics makes effective climate change policy making and implementation impossible, which makes the civilisations of the Earth extremely vulnerable.

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